THE PRINCIPLES OF TREATMENT

OF

Chronic Phthisis Pulmonalis.

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OF

CHRONIC PHTHISIS PULMONALIS.

BY

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LONDON:
LONGMAN, BROWN, GREEN, LONGMANS, AND ROBERTS.

BIRMINGHAM:
CORNISH BROTHERS, 37, NEW STREET.

MDCCCLVIII.

TO

SIR JOHN FORBES, KT., M.D., D.C.L., F.R.S.,

Physician in Ordinary to Her Majesty's Household;
Physician Extraordinary to His Royal Highness The Prince Consort;
&c.; &c.; &c.;

ONE WHO, THROUGH A LONG LIFE,
HAS EXERTED NO INCONSIDERABLE INFLUENCE OVER HIS PROFESSION,
AND WHO,
AMONGST HIS OTHER DISTINGUISHING QUALITIES,
HAS HAD THE COURAGE
TO QUESTION THE GROUNDWORK OF SOME OF THE PRINCIPLES OF HIS ART,
AND WITH A VIEW TO THEIR CORRECTION
HAS BOLDLY EXPRESSED HIS CONVICTIONS;

This Essay

IS, WITH MUCH ADMIRATION, INSCRIBED BY HIS COLLEAGUE,

THE AUTHOR.

Preface.

The occasion which called forth the following essay, prescribed the narrow limits within which it is written. Hence, whilst the author desired to touch upon most of the points which had importance in his estimation, he was compelled to pen his observations in the fewest possible words. He trusts, however, that amidst the press of occupation which besets his medical brethren, brevity will not be unwelcome, and that the reader will regard indulgently the absence of cases and those parts in which he would have desired greater amplification.

Having in common with his colleagues been favoured with a wide field for inquiry in reference to Phthisis, he was desirous to use his powers, both of observation and of reflection, with a view to increase the general stock of knowledge, and, if possible, to find out a new path into which to direct inquiry. A disease, fatal so universally both in æra and place, demands more than the acquisition of recorded knowledge and a belief in the correctness of the views which have hitherto been promulged; for the failure of our remedies which this fatality necessarily proves, clearly demonstrates ignorance and error, and not final truth. In exercising, with great deference to the judgment of others, the privilege to think for himself, he claims that indulgence which is ever accorded to a sincere inquirer; and whilst well knowing that what is new may not be true, he is persuaded that no one having intelligence and a wide field for inquiry can question the correctness of received opinions on this subject without tending to uproot error either by his own labours or by exciting the attention of other observers. The chief aim of the author is to direct attention to that period of the disease and condition of the lungs which precedes the deposition of tubercle, in the hope that, by the aid of many enquirers, that which is unknown may be discovered, and the means obtained for its distinct recognition.

63, Grosvenor Street, London, W,
February, 1858.

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By Edward Smith, M.D., L.L.B., Licentiate of the Royal College of Phyſicians; Aſſiſtant-Phyſician to the Hoſpital for Conſumption and Diſeaſes of the Cheſt, Brompton; &c.

The habit of unthinking routine into which we all are prone to fall, is an infirmity of our nature most opposed to the advancement of knowledge. It is much more easy to continue to act as we have heretofore acted, or to follow the guidance of others, than to ask, why? and obtain an answer. Hence it accommodates itself as readily to the busy habits of this age as to the more slothful ways of former days; and accords as readily with the sensual indulgence of robust health and of youth, as with the inactivity of ill-health and the feebleness of advancing age. I do not think that as a profession we are more prone than others to this infirmity; but, on the contrary, although we decry ourselves on many grounds, if comparative merit might satisfy us, we have little reason to be disquieted; but it is not the less true that this self-deceiving habit is a prevalent curse upon us, both as it regards the improvement of our own minds and of the art which we practice.

Such being the case, it will naturally be the most powerful in reference to diseases or plans of treatment which we think we know thoroughly, or which, on the other hand, we believe it to be impossible for us to understand; and hence in the practically incurable disease now to be considered we lose in hopelessness the determination to seek a cure, and apply our remedies with a *laisser faire* feeling without questioning the grounds on which we either despair or hope for success. To speak of the curability of phthisis is to raise an incredulous smile; and to ask the reason why certain remedies are employed is to obtain a shrug of the shoulder, or a reply that some popular writer has recommended it.

Apathy and carelessness are therefore the common results of such conduct. But to illustrate another infirmity, we occasionally hasten to the opposite extreme, and seize greedily upon a remedy, if it have the sanction of a name, and produce effects which are readily cognizable to our senses; and this equally without having previously inquired whether the improvement affect an essential part of the disease, and whether the remedy has its action upon an effect or upon a cause. In proof of this, I would venture to mention the present indiscriminate employment of cod-liver oil, which, since it improves the digestion of a few, fattens many, and relieves the cough of some patients, is hastily regarded as a panacea fitted to the cure of the disease, and its failures must hide their diminished heads behind the glory of its successes. We have all lived to see one valuable remedy after another cast away from the very excess of zeal which fostered its employment; and as the infirmity of mind to which this is due is common alike to professional and non-professional persons, the latter become even "wiser than their bishops," and hasten to worship the little idol of mesmerism, magnetism, table-rapping, homœopathy, hydropathy, or cod-liver oil, as each may reach the slippery pinnacle of popularity; and it is at the peril of any one who may venture to hint a doubt as to its efficacy for the case in hand. Nay, the infirmity extends even to diseases; and when a new one is said to be discovered by a physician or surgeon of reputation, although it have but the slenderest connexion with pathological conditions, yet because its asserted manifestations are easily cognisant to the senses, the whole civilised world presents, with indecent haste, its bread and salt on golden dishes, and affirms the existence of a disease which they cannot describe, and of an organ which until now they could not discover.

I trust that I shall not be considered presumptuous in thus calling attention to a prevalent infirmity, and at the same time I venture to hope that the time has arrived when a more logical education will be sought after, and a disposition to search after the causes of things will be assiduously cultivated. In no department of the profession is this more needed than in that to which the subject of this essay belongs; and I venture to hope that it will not be altogether without profit to look at this dire disease fairly, and to arrive at conclusions only after having considered the premises. I am but too well aware of the apathy which exists in the profession respecting it, and of the distaste with which many regard it, but am far from thinking that either circumstance is praiseworthy or merited considering the vast mortality to which it leads, and the opprobrium which it has ever been to the medical art.

In pursuing the plan of this paper, I purpose to consider the nature and the causes of the most important vital conditions of a case of phthisis, and then to indicate in outline the principles of treatment. The necroscopic conditions will be for the present excluded.

PART I.

THE PRINCIPAL VITAL CONDITIONS OF CHRONIC PHTHISIS.

SECTION I. GENERAL DESCRIPTION.

On looking at a case of chronic phthisis, we find that it may be of either sex, of any age, stature, condition of life, era, country, season, and clime; or of any temperament, *timbre*, and education of mind, and condition of body: that is, it may be in every form of the human constitution, and everywhere. In many instances the condition of the system has so little changed that the patient is unaware of the existence of the disease until it has very far progressed, and in all cases its attack is so insidious and gentle, and its march so uniform and slow, that it may have existed at birth, or have originated at a more recent period, and yet the period of its origin never have been discovered. At an early period there may be shortness of inspiration and difficult respiration on any unusual call for it; cough occasionally, and more or less spasmodic, and accompanied more or less by tickling in the throat; vomiting occasionally, with cough after meals; variable appetite, but on the whole leading to the taking of an ordinary amount of food; wasting in a slight degree and over a long space of time; indigestion; lessened muscular power but not lessened activity; hæmoptysis in streaks, and with irritation in the throat and violent intermittent cough. The secretions are not generally different from those of health. The colour of the skin is lessened, except in unusually defined patches, and it is more variable. Sometimes a disposition to epistaxis or menorrhagia exists. The pulse and respiration may be somewhat increased in frequency. The throat internally is generally too pale, but with evident injection of the small vessels. The parts look smooth and shining, the uvula is pointed and long, and the arches are thinned. The movements of the fauces are unimpaired. The cough is excited by change of temperature and humidity of the air, and there is some readiness to perspire. The expectoration is very small in quantity, and consists of a little glairy fluid, more or less frothy. To these may be added, frequent pains in various parts of the chest. On uncovering the chest, the ordinary breath movement is less in all parts, and particularly at the upper part; but in deep inspiration, all the parts move in a normal direction, and more or less to their normal degree. The habit of expiration is more forcible than that of inspiration. The respiratory sounds are generally more feeble and short, but particularly at the upper part; but there is no new sound, and particularly none indicating any general impediment to expiration, but that act is short, quick, and forcible.

With the progress of the disease, all these evidences continue and increase, and to them are added others resulting from destruction of the tissue of the lung; but no change occurs which indicates an essential change in the character of the disease. The cough, dyspnœa, expectoration, wasting, debility, vomiting, and rate of pulsation and respiration, increase, the appetite becomes more capricious, the mucous membrane of the throat inflames and desquamates, and that of the bowels inflames and ulcerates; local pleuritic attacks, and attacks of diarrhœa occur, and at length, whilst the mind retains much of its activity, some of its vigour, and the spirits much of their brightest dreams, the sufferer sinks suddenly, sometimes with an evident cause as hæmoptysis, and at others with an internal and not evident cause, as the plugging of a bronchus. But the disease has endured until the vital processes of the whole system have been reduced to the lowest ebb.

Having thus enumerated the leading points for inquiry, we will take each one singly, and in the most categorical manner possible inquire what it has to do as a cause, an attendant upon, or an effect of this disease. But before doing so, it may be well to prefix two or three general rules which should guide us in forming a correct estimate.

I. A condition to be essential must be universal within the same limits.

II. But to assume that an essential condition shall be present in every instance of a disease, is to assume that our knowledge of the disease is so perfect as to enable us to limit it with absolute certainty. This is very unlikely in a disease so general as phthisis, and one which acts so extensively upon the system; and by way of analogy we may call to mind many diseases—as cancer and fever—which, having been thought one at a certain period, have been proved to be many at a later and better informed era.

III. Hence it is probable that in practice an essential condition will not be found in every case of the so-called disease; but if it be found in the vast majority of cases, the probabilities are rather that the remaining cases are not cases of the disease than that the condition is not an essential one; or that these cases have a power, as yet unknown, of preventing the exhibition of the influence of this essential condition. The doctrine of probabilities must here have weight, and in our profession it should have a greater weight than the demonstrative habits of the present day are prepared to allow.

IV. An essential condition having been found, it may have various degrees of influence in different cases.

V. All conditions which are not essential should be excluded when determining the nature of an object; and in the treatment of diseases they must be regarded as subordinate to the removal of the essential condition.

SECTION II. PREDISPOSING CAUSES.

Sex. In the whole of England and Wales, in the eleven divisions, and in thirty-one out of forty-two counties, the excess of mortality, in 1847, was amongst females; but not universally over lesser areæ. In the great towns, as London, Liverpool, Manchester, Leeds, Birmingham, Wigan, and Bristol, and many maritime and fishing ports, men are the most liable; whilst in the agricultural districts the mortality is the greatest amongst women. Hence there is no universal law showing an especial liability of either sex. Moreover, except in diseases of the sexual organs, the mode in which sex predisposes to any disease is unknown.

Age. The greatest liability of age in England and Wales, deduced from a comparison of the deaths from phthisis with the number of persons living at those ages, are the following in their order, beginning with the most intense, and with the exception of the period under *æt.* 1, the greatest liability is limited to the procreative period.

Males ...	0	55	35	25	45	20	65	40	30	50	60	15	4	70	75	80	10	85	5	90
Females .	35	25	0	30	20	55	45	40	15	65	50	60	4	70	10	75	95	5	90	85

But as the disease occurs at all periods of life, the influence of age cannot be that of organisation simply, but of the circumstances attending those periods and influencing the organism.

Stature. The influence of this cannot be determined since we do not know the stature of all persons living in health, and hence cannot determine whether any given height amongst phthisical patients is more exposed to the disease than any other. It is, however, believed that persons of unusual height are greatly predisposed to the disease.

Condition of Life. We have not the means of determining what condition of life is proportionately the most exposed to this disease. The distinction between the rich and poor is neither constant in degree, nor one in kind; and hence the two cannot be fairly contrasted. There is something more than mere nourishment, clothing, and housing, entering into the problem, and that of a nature too immaterial and varying to be estimated.

Era. The disease has been known from early times, and is as correctly described by the ancient medical writers as by ourselves.

Country and Clime. It is said to be infrequent in India, and the Rev. Dr. Livingstone affirms it to be unknown in Central Africa. It was also formerly said to be infrequent in Australia, and it was infrequent in the New England States. But now it is known to be frequent and rapid in its course in Australia, and to be very prevalent in America. It is not the country, but the human beings in it, that have phthisis; and hence the frequency of the disease will depend upon the numbers of men and the circumstances in which they are placed. So far as accurate medical records go, there is no clime free from it; but to estimate the relative liability of various countries would be impossible with our present knowledge, except as regards some of the continental states, and perhaps one or two of the New England States; and even in them how can we dissociate the influence of clime from that of the other circumstances in which the inhabitants live? The accounts of travellers must be fallacious. In my journey through the States of America, and especially in Texas, I never met with a case of phthisis; but how would that prove that phthisis did not exist?

Season. My colleague, Dr. Pollock, in an inquiry made by him at the Hospital for Consumption, &c., ascertained that the spring and autumn seasons were, in 487 cases, those in which the greatest number of cases originated. But since we cannot determine the moment of origin of the disease, and since its course is often that of many years, how may we hope ever to determine the influence of season in its production?

Temperament and Timbre of the Mind. Doubtless the great majority of cases have temperaments of an active nature, and in which the nervous and the sanguine are largely intermingled; but is it not almost equally certain that such is the prevalent temperament of the inhabitants of this country, and hence what proof have we that it is proportionately more liable to the disease than any other? Moreover, the disease is not limited to one variety of temperament, but embraces all with which we are acquainted. It has, however, been impressed upon my mind that in whatever patient I have found a temperament beyond comparison sensitive, I might expect a more certain and speedy death. That, however, is not the natural temperament, but one disturbed by the influence of disease, and hence its importance upon the progress of phthisis may not be that of temperament as it is commonly understood.

Education of Mind. Where is the proof that education of the mind tends more to the production of phthisis than its contrary? A bad hygiene attending education, or a body grown diseased from the bad hygiene, may be a cause; but the disease occurs without education. It is said that the disease has increased with increase of education; but I do not find the proof of it, and if it could be found it is possible that the two might be parallel and not essentially dependent facts. Education as well as ignorance may lead to vice, and in addition have its own peculiar influences in producing circumstances unfavourable to health. No one, however, can doubt that it is possible by ill-arranged study, with its defective bodily exercise, expansion of the lungs, change of air, and mental recreation to injure the system; but the study would not be the essential cause even in such cases.

Condition and Conformation of Body. How can we define the influence of condition and conformation of body, unless we have a standard of health, and a knowledge of the number of persons living having the standard requirement? In a thousand persons in so-called health, how many could be affirmed to have bodies in perfect health? It is probable that perfect health is a myth, and that the most healthy person is so by comparison, not with perfect health, but with systems still less healthy. Hence such systems must be causes of disease, or at least be less potent in resisting the influence of disease-producing agencies; but to state that they are predisposed to the production of a special disease, would demand infinitely more knowledge than we possess, as to the degrees of healthfulness of bodies, and of their influence in the production of all diseases. Whilst, therefore, it may be admitted that phthisical persons commonly have systems not remarkable for their strength, it may be, and it is highly probable, that such is the characteristic of the great mass of persons existing. So far, then, hereditary influences may be admitted in the production of phthisis, but unless it be proved that phthisical persons have much more frequently phthisical progenitors than others have, that could not be admitted as an essential influence. Dr. Walshe has proved, on a small scale, that they have not. Hereditary influence may be most potent, but it is not essential.

Then as to the conformation of the body. Phthisis is met with in all known forms of body, but doubtless more frequently in the narrow and flat chested; yet such is probably the characteristic of a large mass of the community; for our terms narrow and flat have not a relation to a medium type, which is the prevalent one, but to "broad" and "fuller," which may be themselves quite exceptional.

Review. On a review of the foregoing predisposing causes, we may arrive at the following conclusions:

I. That not one of them singly is essential in the production of phthisis.

II. That condition of life, country, and education, are problems too complex, and composed of elements too varying, to permit of an accurate estimate being made of their influence in the production of phthisis.

III. That we know too little of the influence of stature, season, temperament, and condition of body, to estimate their influence.

IV. That age appears to have influence, and one which our present knowledge enables us to define in a general manner; but it is probable that, as with sex, the influence is rather that of the attendant conditions, and that the value of age in the inquiry is to enable us to place limits within which these causes are most powerful.

V. That in order to arrive at accurate conclusions, we must analyse the causes until we have separated all their elements. This is done by considering the influence of food, clothing, exercise, abuse, anxiety, occupation, &c.; although these circumstances singly never act alone, and cannot therefore be estimated with absolute truthfulness, we may arrive at the general expression, that phthisis may be due to some or all of the conditions which induce an excess or a defect in the natural powers or actions of the body.

VI. That although we may not be able to define the extent of the influence of any cause so as to give the proportion in which many of them may relatively be instrumental in producing phthisis, or in which they may be powerful in producing phthisis more than other diseases, we may reasonably be permitted to ascribe to them a certain power in its production, but we must be content with that and not make comparisons, *inter se*, whilst the influence of each is understood.

SECTION III. EXISTING CONDITIONS.

Non-perception of the disease. The fact of the non-perception of the disease by the patient until an advanced period, in many instances, is evidence to show the slow and gentle steps by which it marches, and the absence of pain or of any distressing symptom. The non-perception, even if it extended both to the patient and his friends, would be no evidence against the existence of the disease; but not unfrequently the friends perceive signs which do not attract the attention of the patient. The chief importance of this fact is in relation to the period at which the physician is called to his patient, which is now commonly an advanced one; but a better appreciation of the importance of the early symptoms by medical men would extend to the community, and would lead to an earlier recognition of the disease.

Long continuance of the disease. The long continuance of the disease is no proof of want of unity in the affection in its various steps. But if the moment of origin cannot be determined, how shall the long continuance be proved? The point in dispute is, whether the deposition of tubercle shall be considered the first step in the disease; for if it be, it is assumed that it affords a definite period from which to give it a name and to calculate its duration. But if tubercle were the starting-point it would not give this information, for masses of so-called tubercle are found in the lungs after death, when their existence had never been even suspected during life; and even in cases of disease in which the physician is led to examine the lungs most carefully, the existence or non-existence of tubercle in its earliest condition has ever been a subject for doubt and disputation. No one would, I think, venture to affirm, that in any case of chronic phthisis he could indicate the precise period when tubercle was first deposited. And how should it be otherwise, when we consider that the presence of tubercle is at first to be determined simply by negative and relative signs, and that at the very earliest moment it might be only as a speck in an isolated spot. Its capability to afford signs must be a question of degree, and depend upon quantity, which at first would be infinitely small, and would commonly increase by very small increments, and over, it might be, a small area. Moreover, tubercle in its earliest condition is not far removed in density from that of the lungs themselves, and hence would be some time before it would give the indication which is commonly considered a positive one, viz., dulness on percussion. Hence, assuming tubercle to be its first indication, it is manifest that it is impossible to determine with exactitude the duration of the disease. As the disease advances, the quantity of tubercle yields undoubted signs of its presence both negatively and positively; but there must be a period antecedent to this, which we have not hitherto been able to measure.

I have referred to this in order to show that the difficulty could not be greater (seeing that it is absolute) if we regarded the stage of so-called predisposition as an essential part of the disease; and if the evidences of this earlier stage were as well understood as those of the tubercular stage, this disease would be then as capable of exact and ready definition and detection in the former as it is in the latter. It can be no objection to a candid consideration of it to reply, that hitherto it has not been so regarded.

Tubercle is not the first step in the disease. I venture to affirm that tubercular deposit is not the first step in chronic phthisis, on the following grounds:

I. That whatever tubercle may be, it must be due to anterior causes, and there must have been a period prior to the deposition of tubercle, in which those causes acted.

II. It is universally admitted that a predisposition to phthisis exists and is demonstrable; and so long and widely has this been known, that non-professional people are enabled to indicate its existence. Then as in those persons having this predisposition there is a greater probability that they will have the disease than that they will not, or than that others will have it, there must be a true relation between that state and the disease. Now, assuming that tubercle is the starting-point of the disease, as they have not then the disease they have not tubercle; but as they are the persons in whom the disease—that is, tubercle—is most likely to occur, they are in the stage which precedes tubercle, that is, in the stage in which the causes are acting which must precede and which produce tubercle. I know well that the difficulty lies in proving a connexion between these two states, which is either a necessary antecedence to, or a cause of, the latter; and it is to overcome this that I especially direct attention; but it will suffice if I show that that early condition is a necessary antecedent to tubercle, without being called upon to prove that it is a cause of tubercle, or that tubercle is its necessary consequent.

Evidences of first stage. I consider that this connexion is proved from its own evidences absolutely, and from those contrasted with the evidence which tubercle in its very early condition affords. Its own evidences are shorter breathing, less breath motion, feeble and shorter inspiratory sounds and particularly the vesicular sounds, and this may be more or less general over the whole of both lungs. Expiration quick, forcible, and perfect. Deep inspiration may be effected, but it is not effected by the patient unless at least his attention be directed to the defect, and more commonly not until he has given attention by repeated efforts. This may be readily proved by the inspiration. The quantity of tidal air is often diminished in ordinary breathing. The general indications of body will be those of atonicity, and possibly the rate of pulsation and respiration will be increased, and the complexion and condition of system evince a state of mal-nutrition. There will probably be flattening of the chest, depending upon original conformation or upon the progress of the disease. The same remark will also apply to dulness on percussion. Cough may or may not exist, as also some hæmoptysis. The essence of the whole is less respiratory action; and as this varies in degree, extent, and duration, so will the other signs vary.

The evidences of the disease when tubercle is deposited in its very early period, are the same, but with the addition of those of the existence of obstruction at certain defined places. Hitherto there was lessened action but no localised obstruction, but the deposit of a matter more or less solid offers obstruction to the entrance and exit of the air in the precise spot in which it is placed, and then by extension as the quantity increases. This is evinced by wavy or jerking respiration and prolonged expiration. In addition, the new substance will displace a quantity of air, and then, by its own heavier specific gravity, cause the resonance on percussion to be less clear.

Thus the essential difference in the two stages is, that in the first we meet with simply lessened action and its consequences, whilst in the second there is added obstruction and solidification; and these signs are sufficiently diagnostic, except perhaps at that short period when the two meet, or the first passes into the second stage. The connexion between the two is proved both by the evidences of the first and the continuance of them into the second. We are accustomed to attribute the signs existing with tubercle to the tubercle alone; but this is an error as has been already proved, and also by the further fact that the amount of lessened vital capacity (say 100 cubic inches in the very earliest moments of recognised tubercle) is infinitely too great to be accounted for by the displacement of it by the tubercle, but is readily understood when the conditions attending the earlier stage are admitted.

With regard to the duration of the first stage, we admit universally, under the name of a predisposition, that it is commonly long, and as we cannot deny the influence of defective organisation over its production in many instances, we must admit that in these cases the predisposition may have existed at birth. As, however, the causes of phthisis are not one only, but many, and those varying in influence as life advances; and as we find many cases of persons who in childhood were robust and healthy, but who subsequently fell into phthisis, we are equally entitled to affirm that its duration may be small. This conclusion can the less be resisted when we call to mind the occasional instances in which the diseases could be clearly traced to local causes. Whilst therefore the duration of the first stage is commonly long, it may be short.

Short breathing. Shortness of inspiration must be due to one or more of the following causes: first, lessened muscular effort in some or all of the muscles of inspiration; second, lessened mobility of the thoracic walls; third, obstruction within the lungs due to deposit; fourth, lessened capability of expansion of the air cells; fifth, retention of an excessive quantity of residual and reserve air, whereby expiration is imperfect, and less room is left for the admission of air from without; sixth, air or fluid or solids in the pleural cavities; seventh, the possibility of arrest of the entering current by closure of the larynx; and eighth, a less powerful call for air. It is almost certain that it cannot be due generally to the second, fifth, sixth, or seventh, and before the deposition of tubercle it cannot be owing to the third. Hence, the only causes known which have a general action, can be lessened muscular effort, lessened capability of expansion of the air cells, or lessened call for air; and the second of these may probably be practically excluded until lessened use has existed for some time. Lessened muscular effort may be due to three causes: lessened cerebro-spinal power, atonic state of the tissue, or spasm. The latter may be excluded as a necessary cause, whilst the two former as causes, and the lessened muscular action as effects, are probable causes of the shortness of inspiration. We can only infer the lessening of the call for air, from the lessened quantity inspired, and yet not inducing dyspnœa; and by believing that the diminution of muscular power is not so much greater in the inspiratory than in the other muscles, at this early stage, as to be sufficient to account for the whole result. When tubercle has been deposited, the disease will have continued sufficiently long to have induced a lessened capability of expansion of the air cells, and the tubercle will offer a mechanical resistance to the entrance of air into the part within which it is placed.

Feeble breathing. Feeble respiration results from the atonic state of the system referred to, as well as possibly a lessened call for air. Contrary to the course of nature in most other diseases, there is not an increased effort in healthy parts, resulting from the lessened respiration in diseased parts; but the system gradually accommodates itself to the progressing defect. The proof that respiration is feeble, is obtained from the feebleness of the respiratory sounds, and from the use of the bent tube with a column of water.

Difficult breathing. Dyspnœa does not necessarily exist with the foregoing conditions, and indeed throughout the whole disease it is not observed except after unusually violent respiratory efforts, as cough and exercise. It is immediately due to two chief circumstances: viz., a temporary urgency for increased respiratory changes; and, second, the lessening of the pulmonary circulation, which disturbs the balance between it and the systemic circulation, and is the more perceptible after efforts which urge on the latter. Hence the certainty of the production of dyspnœa will increase as the disease advances, and larger portions of the lung become unfitted for circulation and respiration.

Chest movement. The movements of the chest are well worthy of studious attention. As a general expression, it may be stated that they are lessened both as a whole and, more particularly, at the part immediately covering a portion of lung which is incapable of receiving air. There is no distortion due to any active condition, such as that of spasm of any of the respiratory muscles, but only to the passiveness resulting from inactive lung structure. This is, however, a constant and marked cause of distorted action, since the two sides of the chest are not always diseased at the same time, to the same extent, and in the same degree; and hence, whilst there may be much respiratory movement on one side, there may be passive immobility at the corresponding part of the opposite side. As a rule, this inaction is greater at the upper than at the lower part, and does not in any part, except in very advanced conditions, extend to the intercostal muscles. At the lower part, the cartilages of the lower ribs in front move upwards and outwards in the same direction, but not to the same extent as in health, and there is at the base often a considerable action of the intercostals, and width between the ribs.

But besides the localised deficiency in movement, there is a general deficiency in the earlier stage, and a further irregularity which is worthy of notice. In the earlier stages, it is of common occurrence to find a want of correspondence between the apparent effort and duration of inspiration and the extent and duration of the inspiratory movements; so that the patient, when directed to deeply inspire, appears to be and believes himself to be inspiring when, in fact, the movement of the chest and the further introduction of air have both ceased. This is remarkable and of daily observation, and with it we usually find a short and snatching inspiration. The power of expiration is perfect—short, quick, and forcible—and often seems to have obtained the muscular effort which the patient has lost in reference to inspiration; but at the same time there is in some persons a disposition to retain a larger quantity of air that is natural under the circumstances, and thus to lessen the depth of the succeeding inspiration. These irregularities are so marked and frequent amongst my out-patients at the hospital, that the thought is impressed upon the mind that men and women need to be taught how to breathe. In such cases, if we ask for a deep breath we obtain a short and feeble inspiratory effort, and then a sudden forcible and complete expiratory one, and if the act is repeated frequently the length of the expiratory act is lessened, but its rapidity and force are maintained. The aim of the patient seems to be to empty and not to fill the lungs; and it is only by making this apparent to him, and enforcing it by an illustration in my own person, that he comprehends the error, and after that it is often impossible to induce him to take the deep inspiration which he ought to take. The importance of this error is very great, since it tends directly to prevent due expansion of the lungs and to induce a train of consecutive evils.

Now, to what is this state to be attributed? It is not to obstruction within the chest by any deposited substance, since it occurs when there is no deposit as also when the deposit is inconsiderable, and, it may be, is restricted to one lung alone. When it occurs with extensive deposit it is less remarkable, and I believe it to be less frequent under these conditions. The two most patent causes are deficient muscular action and closure of the trachea. The former may simply result from the general atonic state of system with which it is commonly associated; but it is, I am convinced, due often to a condition of some of the muscles, which orthopœdic surgeons have of late frequently regarded as paralysis, but I think without sufficient reason. The special muscular power exerted in inspiration is proportionately less than the power of other muscles in the body. It is not that the walls of the chest are less mobile; for, on the contrary, the tonicity of the ligaments and the cartilages is perhaps lessened, and therefore their resistance is decreased. Hence they would move if the motive power were adequate. This is also capable of proof from the fact that by more attention and effort on the part of the patient, the inspiratory movement does increase. The involuntary closure of the trachea, such as occurs on coughing or when we use much effort, as in lifting burdens, and as we are able to induce voluntarily at any moment, is, I am convinced, of very frequent occurrence. The patient, in obeying directions to take in a deep breath, snatches a breath and the effort stops suddenly, and at the same time there is a motion about the larynx which attracts attention. It almost always occurs that he breathes through the nose, and when directed to breathe through the mouth, and with an open throat, and to feel the air passing down the throat, he is enabled to increase considerably the volume of air which he inhales. This is most readily obvious when using my spirometer to determine the total vital capacity, and then it is not infrequent to obtain an addition of 30 cubic inches to the quantity previously breathed. This obstruction is, therefore, an involuntary act, but one which volition can overcome; but although it may be overcome by practice, it seems to be an almost insuperable difficulty at the first. It is one of the greatest obstacles to free inspiration with which I have to contend; but yet one which, whilst it has led to much injury to the system, offers much more hope and encouragement in the treatment of the disease than would be the case if the existing degree of inaction were entirely due to internal deposit. It is a bad habit resulting from deficient muscular power, and is not infrequent in states of chronic debility from other diseases.

Flattening of Chest. Flattening is, earlier or later, always associated with deficient mobility of the thoracic cavity, and in phthisis is always in the antero-posterior direction. This is both general and local, and must be associated with lessened inspiratory action of the air cells, or, in other words, with a lessened quantity of air admitted into the lungs, either as a whole or in parts. With this latter circumstance the lungs cease to retain their full volume, and become more or less atrophied; but as in phthisis this change is coincident with, or not long anterior to, the accumulation of tubercle in that part of the lung, the bulk of the lung is maintained in a degree disproportionate to the quantity of air which it may admit; hence the flattening is not so great as it becomes when a large portion of the lung tissue has been removed and a large cavity has been formed, for then the walls of the thorax often present a marked falling in precisely over the region of the cavity. This circumstance is the most perceptible above and immediately below the clavicle in which position the mass of lung is not great, and the injury is proportionately the most extensive.

Respiratory sounds. I believe it to be incontrovertible that in the earliest stage of phthisis the respiratory sounds, universally or locally, are more feeble than in health. This is coincident with lessened inspiratory action, and both exist for an uncertain period before flattening of the chest occurs. The respiratory sounds in health are limited, so far as we know, to the bronchi and to the air vesicles; for whether any portion of them is due to movement of blood in the vessels has not been determined. The bronchial sounds in health are alone heard over the large bronchi, but in disease they are also very audible in the smallest bronchi, whilst the vesicular sounds are heard wherever there are air vesicles in action; and in health they prevent the perception of the sounds in the smallest bronchi. The vesicular sounds, moreover, vary in intensity with the action of the vesicles, and are feeble when the vesicular action is feeble; and when they are feeble to a certain degree, they permit the bronchial sounds to be heard. Hence, lessened vesicular murmur indicates lessened vesicular action, which is evidence of lessened movement of the lungs, and of lessened chemical and physical changes in respiration. This first indication may exist for some time, and must have proceeded to a certain extent before the next evidence of disease, viz., harsh respiration or bronchial breathing, is superadded; and with both, the only attendants may be lessened chest movements and consequent shorter inspiratory *trajet*. After a period, to these three will be added flattening of the chest; and all may and do exist in every case of chronic phthisis before tubercle is deposited, and constitutes what I have denominated the first stage of the disease.

The order of these signs will be—

I. Lessened chest movements; shorter *trajet* of air; short and feeble inspiratory sounds.

II. Flattening.

III. Bronchial breathing.

The only sign of this earliest stage which is open to dispute, is dulness on percussion, and that arises from our inability to detect the slightest change from health, since the sign is always relative, and many degrees of it are all expressed by the one common term, with the addition of the qualification, "little" and "great." Hence there must be a period in every case when medical men will differ as to its existence even, and much more as to its importance. It is, however, evident, that as the clear sound on percussion in health is due to a certain relative proportion between the æriform and the solid contents of the chest, it will vary as this proportion varies, and will increase in emphysema, or even in a well-filled chest, and decrease when the action of the air vesicles is lessened. Hence, with the occurrence of the latter, there must coexist the former, but both must have progressed to a certain extent before they can be detected, and still more before their existence would be admitted by those who regard that sound only as dulness which results from the percussion of a solid body. Hence, in the first stage, dulness must be theoretically present, but practically may not be perceptible at the period of the disease then under examination.

With the occurrence of tubercle, there will be superadded signs of obstructed breathing, viz., wavy or jerking inspiration and prolonged expiration, increasing locally as the accumulation increases, and with these all the above-mentioned signs increase in intensity in the place where the tubercle is found. The obstruction required in order to the production of these signs must be partial and lateral as opposed to complete and terminal; that is, it must occur in the course of the air-way, and leave a portion of the conduit open, so that the air may be forced beyond it. When all the air cells of an intercellular passage are filled with tubercle, they cannot *directly* induce these sounds, but they do so *indirectly* by pressing upon adjoining air cells and minute bronchi. Absence of vesicular murmur, with its consequences, is the only direct sign of such a condition. After an uncertain period, there will be the further addition of moist sounds, indicative of air passing through a fluid, which in this instance is softening tubercle. There is no reason theoretically why this should not at the first occur, whilst the tissue of the lung is unbroken, for the softening of tubercle is not a corroding process, like that of ulceration, but simply the imbibition by endosmosis of fluid by the tubercular mass by or with which the mass softens, and the process of tubercular transformation or degeneration is hastened. As the mass is extra-vascular, it is manifest that it must obtain the fluid with which it softens from the walls of its cell, and not from the centre of the mass, as has been affirmed; and this will be the case how many soever may be the cells implicated in the softening mass. This process may be non-inflammatory, but exudation of pus corpuscles always occurs at some period, and that is presumed to be the result of inflammatory action. The reason for the destruction of tissue is not simply the softening of the tubercle, nor any inflammatory or ulcerative action; but the basement membrane and capillaries having ceased to act for a time, lose their vitality and are ready to decay, and only wait for the partial emptying of their contents in order to break down. Moist fine crepitant rales when localised in a tubercular mass are practically held to indicate the destruction of tissue, and although it may not be so at the earliest moment, it soon becomes so in every case. The softening of tubercle and the destruction of the cell walls having begun, it only remains that those processes shall go on until all the tubercle has been eliminated and a cavity results; and thus the whole are but steps of one process, and, in truth, are one stage of the disease. With softening, the bronchi are reopened, and air is admitted, which produces the moist sounds, and ultimately all the signs which are indicative of a cavity; but with the restoration of respiration there is no increase of respiratory changes, since the air cells in that part are destroyed or perhaps removed. With the formation of a cavity, the lung falls in as do also the parietes of the chest immediately covering it, and the dull sound on percussion will in part have disappeared.

Thus, the essential signs of the three stages may be thus epitomised: first, lessened action; second, obstructed action; third, destroyed lung.

There is no reaction or compensating effort set up by nature in this disease whereby one part of the lung is made to do a double share of duty when another part is incapable of performing its function. Such a power is much less frequently exercised in chronic than in acute diseases universally; but in none is it so remarkable and constant as in phthisis; so that the system quietly accommodates itself to the induced condition. Increase in the rate of function does not come under this denomination, since that increase is not partial, but general, and to both sound and diseased parts alike.

Cough is not uncommon in health, and therefore may be reasonably expected in even the early stage of phthisis. It is, however, then only intermitting and irregular, and is severe only as an exceptional occurrence. To what is it then attributable? It is the fashion to give it a philanthropic character, and to affirm that it always exists with the good intent of removing something which, by being allowed to remain, would be hurtful. It is so doubtless sometimes, and at this early period it *may* result indirectly from the lessened freedom, whereby carbonic acid is removed from the air cells: for, on the one hand, the lessened vesicular action and feeble respiration must give less effective aid in the removal of the carbonic acid; and, on the other, the first outward effect of any impending suffocation is cough. This, however, is the only benign influence which it can exert in this stage, for it would be absurd to suppose that the very small quantity of expectoration which then commonly occurs, demands violent fits of coughing, even if they were only occasional. It is said to be due to a state of general nervous excitability; but if the existence of the latter might be admitted, we must still find the exciting cause which shall determine the excessive nervous action in this particular direction. I think the state does exist, and that it has an influence not to be overlooked; but I also consider that there is a localisation of it in the throat which is the most important. The nature of the cough is either short and frequent or of a spasmodic kind, and so violent as to induce vomiting if any food be in the stomach. In both forms there is tickling in the throat, and in both also it is especially observed to follow the mechanical effort of swallowing food, and on exposure to changes of air whether these be towards cold or heat. These two are the ordinary excitants of reflex motor action in the fauces; and to these may be added a third by continuance of faucial efforts; for although the throat is at first pale with detached injected vessels, implying simple atonicity, it will be found that the movement of the arches of the palate, and particularly of the posterior ones, have increased, and with that increase there is often hypertrophy of the pillars of the posterior arches at their termination in the pharynx, and with increased size and action there will be increased nervous influence. Whilst, therefore, I believe that there is increased general nervous excitability, and that it may be directed to the production of cough by the more or less powerful, but ever present, cause of insufficient evolution of carbonic acid from the air cells, I feel assured that the more imperative cause is localised about the fauces. Hence it may be simply an attendant circumstance, or indeed a precedent one, and, at the same time, a resultant condition; and whilst it will ever attend the disease, it is not practically beneficial in the former sense, since it in no way aids to remove the condition to which the lessened evolution of gas is essentially owing, and in the latter sense its continuance must be an increasing cause of its own increase, and in the production of various secondary ill effects. I do not think that it would affect the result if we admitted that the pharynx is only the reflected site of the reflex nervous action which combines the respiratory efforts to produce cough, whilst the real excitant exists in the air cells; for whether the action in the pharynx be direct or reflected, it is equally to be benefited by direct treatment.

In the later stages a certain amount of cough is demanded in order to the removal of the secretion; but it commonly exists in great excess of that necessary amount, and is chiefly due to the diseased state of the mucous membrane of the fauces—a state commonly of desquamation of the epithelial layers, and of great engorgement of the small vessels.

Nausea. Vomiting is not dependent upon causes seated in the stomach and alimentary canal, but on the condition of the pharynx and other causes inducing cough, and hence the vomiting is always preceded and accompanied by cough. It occurs chiefly after meals, when the mechanical efforts of deglutition have excited the nervous irritability of the pharynx, and when the stomach being distended there is a greater readiness to excite the instantaneous action of the diaphragm. It also occurs frequently with the first violent cough of the morning, and again at any time when the cough is violent. The cough, and particularly the sensitive condition of the pharynx, is its immediate cause; and when both are only moderate in degree there is no vomiting.

In fifteen patients, in all stages, during a whole month, there was vomiting in only two. In one it was 16½ oz., 2 oz., 4¼ oz., 23¼ oz., 80 oz., 4½ oz., 40 oz., 2½ oz., 50 oz., and 2½ oz., on different days, in the early stages. He was very sensitive, had been intemperate, and died of brain disease.

Conditions of the Throat. There are various conditions of the throat met with in phthisis, each of which calls for separate investigation and treatment; and taken generally they may be arranged under three heads. They are illustrated by the coloured drawing No. 1.

I. A state of pallor without injection of the vessels and without desquamation or inflammatory action, as in fig. 1. This is a condition very frequent in the earlier stages of the disease, and is made known to the patient by a sense of dryness which induces cough. In this condition the sensation is generally referred to the fauces, pharynx, and upper part of the larynx alone; and it is the most annoying in the early morning and on changes of temperature. The surface does not always appear to be dry, but is smooth and shining, and the parts are attenuated. The anterior arch is atrophied, whilst the posterior stands out in sharp relief, and the intervening space is large and excavated from the absorption of fat from the areolar tissue, and oftentimes from a diminution in the size of the tonsillar glands. The latter organs seem to be of looser texture, and to have their superficial follicles projecting. This condition is one of lessened tonicity with increased sensibility, and with a diminution in the secreting function of the epithelium and mucous follicles. It may or may not be associated with derangement in the excreting

N° 1

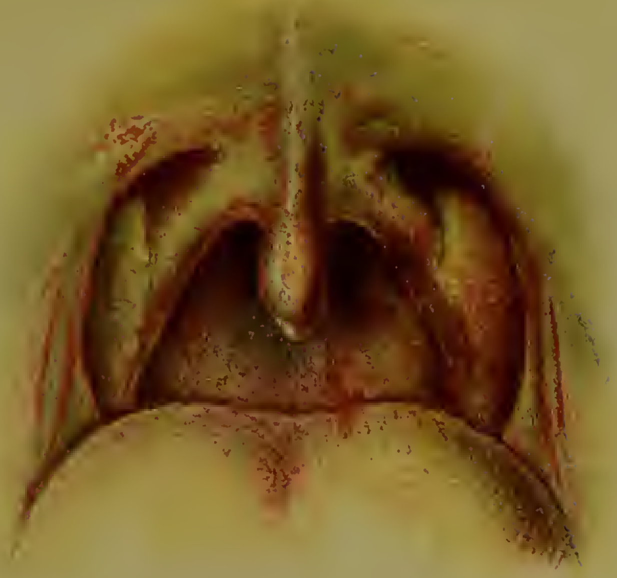


Fig 1.

Fig 2

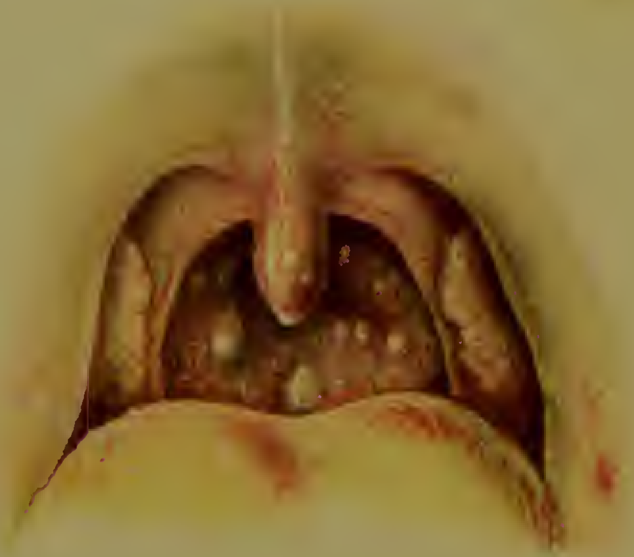
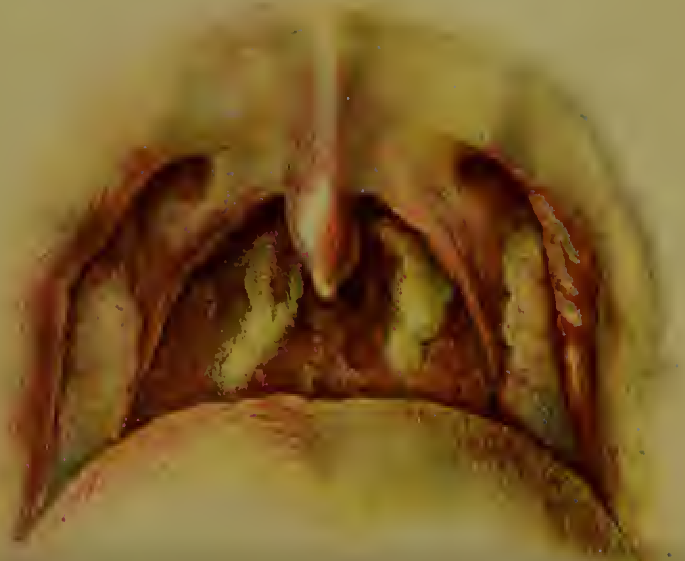


Fig 3



EXPLANATION OF PLATE I.

These have been drawn, from cases under my care, by Mr. Turm, and illustrate three common conditions of the throat in phthisis. A fourth condition, or that of general redness and looseness of the parts, would have been included, had a case presented itself at the moment.

Fig. 1 represents the most common condition of the throat, viz., one of great pallor with absorption of fat, atrophy of the anterior arch, and undue prominence of the posterior arch.

Fig. 2 shows the enlarged mucous follicles upon the uvula and the posterior wall of the pharynx.

Fig. 3 exhibits a state of desquamation, with effusion of lymph upon the pharynx, and general vascular congestion.

organs, and is always amenable, temporarily, to local treatment as well as to the influence of general sedatives. I find in this stage that the application of a mixture of equal parts of chloroform and olive oil, by means of a large brush, is most useful, provided it be repeated every second day, and be thoroughly applied as far up the pharynx as behind the velum, and as far down the pharynx as possible; for, as a cause of cough, its site is limited probably to that part of the pharynx. A strong solution of suet in milk (℥ j to ℥ vj), and applied often by table-spoonsful, quietly and slowly swallowed, is most useful. In some instances the greatest relief is afforded by a strong solution of nitrate of silver. Morphia in minute doses is very useful in this stage; but it is in this stage especially that I have met with coughs which have resisted the influence of the general sedative and succumb to the local treatment. There cannot be a doubt, also, of the necessity for a general tonic and chalybeate plan of treatment in this condition of the parts; and I would earnestly call attention to this condition because it has not generally been considered as a disease.

II. A condition in which, whilst there is pallor of various parts of the fauces, there is injection of defined vessels in some parts, with more or less suffusion in others, and at each the parts appear to be loose and relaxed (fig. 2). The distended vessels are most evident upon the uvula, and the diffused redness, on and between the arches, and upon the tonsils. Besides these, however, there is one condition which is very marked in many instances, viz., enlarged mucous follicles, chiefly on the pharynx, but also upon the uvula, and sometimes on the arches, appearing as small more or less coloured vegetations; and it is not unusual to find ulceration or enucleation of some of the follicles of the tonsil, and chiefly at its upper part. The uvula is commonly enlarged and elongated. In this condition there is commonly less sensation of dryness and irritability in the fauces than is found in that before described; but there is a troublesome sense of constriction or irritability at the lowest part of the trachea in the neck, and it is more commonly there that the patient at once directs attention. He is, however, annoyed by a sensation of phlegm adhering to the parts about the fauces, and is induced to continue a cough of some force with the view of detaching it. This state is commonly associated with disordered action in the alimentary canal or the liver, and is to be treated through those parts; but it is very greatly benefited by the application every third day of a strong solution of nitrate of silver, care being taken to brush every part well where the vessels are enlarged, or where there are vegetations, and to use an abundance of the solution so that much shall be left by the brush upon the mucous membrane.

III. The third form is one of desquamation, of fibrinous deposition, or of ulceration, and is generally met with only in the advanced cases (fig. 3).

The desquamation is in patches, with or without a fibrinous exudation, and chiefly in the pharynx, and in the arches of the fauces. The fibrinous exudation is of a cacoplastic kind, and lies as a layer upon the denuded mucous surface, and may be partially removed by the brush when used to the parts. In this condition there is more general redness of the parts of a dull hue, and is often accompanied by hoarseness which has progressively increased in intensity. On inquiry, the patient at once complains of the throat, and frequently states that it is more disagreeable to him after—not during—a meal. The tonsils are often enlarged, and participate in the general redness, and the fauces are more or less laterally contracted. There is also frequently a complaint of soreness and tenderness on pressure about the larynx, both on the sides and below the Pomum Adami. In this condition I have often found the free application of the strong solution of nitrate of silver, and especially to the lower part of the pharynx within our reach, to be followed by alarming choking; and upon the whole there is exalted sensibility, not so much of a simple nervous kind, as was mentioned under the first head, as that resulting from inflammatory action and destruction of tissue. This will of course vary with the chronicity and intensity of the conditions existing. As a local application, I have found great benefit from equal parts of oil and liq. potassæ, well laid on with a large brush; a mixture of cod-liver oil with an alkali, taken internally, but swallowed very slowly; or an alkali, as soda, with the tonic then in use, also drank slowly; and in each case I believe there to be a local topical influence excited. The secretions of the mouth and throat are very acid, and hence call for the topical use of an alkali; and with the sensibility from inflammatory action, oil of a certain viscidity is very valuable. The external application of blisters is often called for, as also the administration of gentle purgatives. It is particularly necessary to avoid speaking, and the swallowing of mere secretions; and of all articles of food, suet and milk are the most useful. The latter is also a valuable medicinal agent if it be used in small quantities, and whenever the throat is unusually dry and irritable. I do not think that in this class of cases the application of the strong solution of nitrate of silver is so useful as in the former category.

In each of the classes of cases now described, whenever it is intended to make a topical application to the mucous membrane, the mouth should be well opened, the tongue held down and drawn a little forward by a broad spatula, the patient directed to breathe at his ordinary rate, and to breathe through the mouth, or the whole of the surface of the pharynx which it is essential to medicate will not be exposed. A camel's hair-brush, quite as large as the end of the little finger, should be used; and, after having been well dipped into the solution, must be carried dripping into the fauces, and be well rubbed upon the pharynx as high up behind the velum, and as low down towards the epiglottis as practicable, as well as in other places, and the good to be effected will depend upon the use of a sufficient quantity of the remedy, and upon its extensive and uniform application.

I think that too much importance cannot be attached to this branch of the subject, for not only will the patient's comfort be increased (whether he have complained of his throat or not), but the necessity for the use of sedative medicine may be greatly lessened. I am also of opinion, that notwithstanding the attention which has been given to this subject by our American and continental brethren, as well as by ourselves, we are in want of additional local remedies; and especially of such as the patient may apply.

The explanation of the conditions now discussed is not simply that those which affect other parts of the mucous tract act here, but the special ones which are inherent to them and to their use. Thus the special sensation which guards the larynx and pharynx, which is the seat of the irritation inducing cough, is restricted to a small surface of the pharynx, or to all that which can be seen when the mouth is widely opened, and a little further both above and below. The injurious effect of volumes of cold air received by the mouth is directed upon this sensitive part. The acts of swallowing, speaking, and all those connected with the respiratory movements, are centred there, and hence there is constant motion and frequent local irritation. In all the conditions referred to, the movements in the throat connected with respiration, deglutition, &c., are perfect. The prevention of the irritation from cold air is most important, and demands that the patient breathe by the nose when in cool air, so that the temperature of the parts may be maintained. From my inquiries I find that the temperature of the expired air, is from four degrees to eight degrees higher when inspiration is effected by the nostrils, than when the person breathes through the mouth. It is more than probable that the benefit of respirators is in preventing inspiration by the mouth, and thus requiring the patient to use the natural respirator—the nose; and it is in this mode that cough may be most effectually prevented. When the air is both cold and moist, this precaution is yet more important, for under that condition the animal heat is more quickly and certainly extracted.

Sputa. The expectoration has of late been made the subject of minute inquiry, but without having as yet (with one exception) added anything which is indisputable to our knowledge. The exception to which I refer is the discovery of the yellow elastic fibre of the lung tissue in the sputum, in the early stage, as evidence of early softening and destruction of tissue. I have had specimens in my cabinet for some years which exhibit in the sputum a large portion of the elastic tissue of an air cell. When there is no mistake as to its nature there can, I believe, be none as to its source; but I have constantly seen mistakes made; and in the hurry to find elastic tissue as proof of destruction, small portions of what appeared to be a bit of fibre, without its physical characters, were affirmed to be the elastic tissue. When destruction of tissue occurs, there can be no doubt that as the elastic tissue is not easily disintegrated, it will be emitted with the sputum, and so far it is evidence of destruction; but the nature of that destruction may be various, and can only be proved to be tubercular by the attendant signs and symptoms and the greater relative frequency of phthisis over every other destructive disease of the lung. Hence it is not of itself diagnostic of phthisis. Moreover, when the softened portion of the tubercle has been emitted, and a cavity, lined by a membrane, has been formed, no further emission of elastic tissue can occur from that part; and hence phthisis may exist and be advanced, and yet no elastic tissue be found in the sputum. With these limitations, however, the discovery has value; and in a case of bronchitis, complicating and masking tubercular disease, it may render essential service.

But in reference to the more triumphant discovery of tubercle in the sputum, we must be much more guarded That tubercle in a disintegrated form should be present in the sputum, after softening and destruction of tissue have proceeded for a time, must be a necessity at some period of the case, and must continue until the cavity is formed and emptied. This is described as free granules with fat, with or without free vesicles and the so-called tubercle cell; and I believe that there is reason for affirming that it indicates the presence of degenerated and transformed animal matters, and so far only would be corroborative (if at that stage corroboration were wanting) of the existence of tubercular softening or a cavity. But interesting as the information may be (if it were indisputable), it is of but little practical value, since the cases would be few in which the other evidences of the existence of softening tubercle would require its support, and if the diagnosis of this case, from other deposits in the lung, were doubtful, its assistance could not be relied upon.

The main point of dispute, and also of importance, is the possibility of detecting tubercle in its earliest form, that is whilst yet a corpuscle, with enclosing walls and contents; for if that could be done in the sputum it might materially assist the diagnosis at the early stage, when assistance is really valuable. But to do this would imply two things—first, that we shall agree as to what is a tubercle cell; and second, that we should be able to prove that it may be emitted through the minute bronchial tubes, whilst the integrity of the air cells is preserved; for without the latter we should be unable to find it until a later period, viz., that of destruction of tissue. Now, in reference to the former, there is not the required agreement, and, therefore, at the most the question must be still regarded as one for inquiry. It is figured as a single corpuscle (or a nucleus), as a corpuscle with a membranous appendage (or an epithelial cell), as a compound corpuscle in which there are one or more nuclei or nucleoli, and a compound cell, in which, connected together by one membranous expansion, are many cells, containing each, one or more nuclei. It is difficult to believe that, if tubercle be of one nature, it should have so many varying forms, unless it be shown, which it has not been, that they are so many steps in the progress of its development.

An essential link in the chain, and one which is not by universal agreement supplied, is the knowledge of the form and transformations of the epithelium of the air cells of the lung. I believe in its existence, because I have constantly seen it ; and I do not find on reflection anything which I have seen or read which would refer the appearance to any other cause ; and if it do exist, I confess that I do not see a dissimilarity between it and some of the cells found in a mass of tubercle. I believe one source of disagreement to be either attaching an importance to the nucleus which is not given to the membranous expansion, or assuming that the nucleus is or is not a perfect cell without the membranous expansion. The tessellated epithelium has an expansion of basement membrane, and also, in its natural state, a nucleus which is a cellular body, and is probably the essential part of the whole, and may exhibit various transformations by reason of its own development. The nucleus may be detached from the membrane certainly with disintegration of the membrane, but whether without the latter I do not know. Thus the mere absorption of the membrane—that is, of what I believe to be the non-essential part—would be a transformation. This development of the nucleus would be a further step in the process, whilst the appearance of granules within the cell would be a still further step ; and the last to which as a cell it would be exposed for the final step, is the rupture of the cell wall and the escape of the granular matter in the form above described.

But if all this were admitted, the question would arise why a natural structure in the body should put on these degenerative changes, and why it should not always do so ? Our present information is alike insufficient to determine with certainty what is and what is not tubercle, and to answer the inquiries in reference to the transformation of epithelial cells ; but we have enough information to induce us to look forward to the time when these questions shall be settled by common agreement.

In reference to the second alternative, viz., that tubercle may be emitted by the bronchial tubes, without any destruction of the air cells having occurred, I think no one could deny the possibility ; for as normal epithelium and effusions into the air cells do doubtless pass into the bronchi, we may by analogy assume that there is a stage of the disease when tubercle, whatever may be its nature, may pass also. But we readily infer, that whilst this is possible it is not usual, or there would be no reason why the tubercle should accumulate in the air cells, or why the disease should almost constantly progress. Hence, proof of the presence of tubercle in the sputum would practically, though not theoretically, imply the existence of destruction of lung tissue.

The sputa met with in the earliest condition of phthisis is very small in quantity and variable in appearance, but does not differ materially from that expectorated in health, and is most commonly the product of the tonsillar and other mucous follicles and glands situated in the fauces. In it may always be found epithelial scales of the squamous and sometimes of the columnar kind, and not unfrequently pigment cells with a matrix of glairy albuminous material, and containing often mucous corpuscles. It is in no way diagnostic of or peculiar to phthisis. There will also, at this period as in health, be occasionally secretion from the mucous membrane of the bronchi, when the pigment cells, the columnar ciliated epithelium, and the mucous corpuscles will be more abundant.

In the stage of softening, even if that occur before the lung is extensively diseased, there may be superadded to these elements the tissue of the lung, free fat, and free granules, with the cellular elements still in dispute; and these, with the addition of blood corpuscles, will constitute the organised parts of the sputa throughout the disease. Less attention is now given, than would formerly have been thought right, to the figure of the sputum; and the presence of oil in the sputa can no longer be regarded either as a means of diagnosis between bronchitis and phthisis, or as peculiar to phthisis, since fat is constantly found in the excretion from the bronchial mucous membrane. We have now far better means of diagnosis.

The quantity of sputa in fourteen cases, in the stage of softening, in May and June, was on the average 2·8 oz. per day, and varied from an average of ·75 oz. to 5·9 oz. per day. These quantities, however, include the weight of the saliva spat in smoking. The two cases having the largest average quantity of sputa did not smoke, and yet in each the sputa in two days amounted to or exceeded 8 oz. per day. In another case, in which the total average was so much as 5 oz. per day, the sputum, apart from the saliva spat in smoking, was so much as a minimum of 3 oz. and a maximum of 6 oz. in the day. In none of these cases was death at all imminent. The case having the least quantity—viz., an average of $\frac{3}{4}$ oz. per day—was one of double phthisis, with softening, in a quiet state, and associated with Bright's disease. Thus the quantity of the sputa may be a serious drain to the system, or it may be of little moment even in an advanced stage; and it is not proportionate to the extent of the disease.

Appetite, and quantity of food. The appetite, although variable sometimes, is generally as good as in health; so that the quantity of food taken is abundant for the purposes of the system. I found that during a month the average daily quantity of food taken by seven less advanced cases was 27·7 oz. solids, and 71·7 oz. fluids; and this sufficiently large quantity is corroborated by daily inquiries. The following is the diet roll of one patient for a month, showing a daily average of 40·1 oz. solids, and 103· oz. fluids. He was a Life-guardsman, six feet one inch and a half high, and thirteen stones in weight; but although still fresh looking and fleshy, he had lost much flesh and strength.

DIET ROLL OF A MODERATELY ADVANCED CASE OF PHTHISIS.

TABLE No. I.

	MAY.																	JUNE.										
	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Cod-liver Oil . oz.	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½										
Meat	6	6	6	6	6	8	10	6	10	8	6	6	6	6	6	6	6	2		5	6	2	6	7½	7	6	6	6
Fish	3	3							1				2				3½	60 gr. 1		4			½	3½				
Egg	2	2	2¼	4¼	2	2½	2½	2¼	2¼		2	4	2	60 gr. 2	60 gr. 4¼	4	60 gr. 2	4½		60 gr. 3½	60 gr. 3¾	60 gr. 2¼	60 gr. 2	2¼	60 gr. 2	2¼	2¼	60 gr. 2¼
Butter	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½		1	1½	1½	1½	1½	1½	1½	1½	1½
Bread	24	24	24	24	28	28	27	26	26	30	28	25	22	28	27	30¼	27½	19		9	19	12	18	16	17	20	15	14
Potatoes	5	5	5	6	4	4	5	5	5½	5	5	5	5	5½	4¾	4¼	60 gr. 5	60 gr. 4		6	4		6	6	5½	4½	6	5½
Sugar	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½		1½	1½	1½	1½	1½	1½	1½	1½	1½
Cresses																					60 gr. 1¾	¾						
Cocoa		10																										
Milk	8	8	8	16	16	16	16	16	16	16	16	16	16	20		20	20	13			10		10		14	10	10	
Coffee	30	30	40	20	20	20	40	40	20	40	20	20	30	20	20	28	40	20		10	36		28	18	20	20	20	20
Tea	50	40	40	40	40	30		40		30	30	30	30	30	28	22		20		52	26	43	18	18	18	20	24	36
Ale	8	8	8	8	8	8	8	8	8	8	8	8	8	20	30	30	20	20		20	20	40	34	20	20	20	20	15
Water	30	30	20	30	30	30	30	20	20	30	30	30	30	30	4	4	4	4		6	20	16	16	16	16	8	8	8
Medicine	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2		4	4	2	2	2	2	2	2	2
Total solids	43½	43½	40½	43¾	43½	46	49	42¾	48¼	46	44½	43½	40½	45	45½	47	63 gr. 47½	120 gr. 34		60 gr. 30	60 gr. 37½	60 gr. 20	60 gr. 36½	38¾	60 gr. 34½	36	32¼	60 gr. 24¾
Total fluids	127	129	119	117	117	107	97	126	66	126	106	106	116	122	80	106	86	79		92	116	101	108	74	90	80	84	81

In the last stage the appetite is still more variable, and the quantity of food is reduced; but on the average of seven advanced cases for a month, it was 21·5 oz. solids, and 64·2 oz. fluids, daily.

As we have given the diet roll of a patient at one extreme, we will now give that of a patient at the other—of one who was extremely emaciated, and had the most extensive destructive disease of both lungs. He was *æt.* 23, height 5 ft. 7 in., weight 6¼ stones, and the daily average quantity of ingesta was 19·7 oz. of solids, and 54·8 oz. of fluids.

DIET ROLL OF A VERY ADVANCED CASE OF PHTHISIS.

TABLE No. II.

	MAY.																	JUNE.										
	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Cod-liver Oil . . oz.				½	½	½	½	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	¾	60 gr. ¼						
Meat		4	4	4	4	4	4	3	4	4	4	4	4	3	4	4	4	3	3	3	3	2½	4	4	6	3	4	4
Fish						2																						
Egg							1½	1½	1½	1½	3	1½	1½	1½	1½	1½	1½	1½	1½	1½	3½	1½	1½	2		1½		2
Butter	1½	1½	1½	1½	2	1½	1½	1½	1½	1½	1½	1½	1½	1½	2	2	2	2	2	2	2	1½	1½	1	1	1	1	1
Bread	10	8	6	9	8	8½	8	8	7	5	8	7	7	6	7	7	9	8	6	8	6	6	5	6	7	7	6	6
Potatoes		6	5	5	6	2	4		4	4½	4½	4½	4	4	4½	4½	2½		4	2½	4	2	4	4	3	2	4	5
Rice						2	2									Pudding 2			2	1				3				
Sugar	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1½	1	1½	1½	1
Fruit and Cresses. .							1½														1½							
Beef Tea	8																											
Cocoa	20	20	20	10	20	10	20	10	10	20	10	20	20	10	10	20	20	10	20	10	15							
Milk (Suet)	8	8	8	8	8	8	8		16	8	8	8	8	10	10	10	10	10	10	10		10	20	30	20	30	20	20
Coffee					10	10	10																					
Tea			10	20		10		10			10	10	10	10	10			15	6		5	15	5	5	5			5
Ale		8	8	8	8	8	8		8	8	8	8	8	10	10	10	10	6	10	10	10		10	10	10	10	10	10
Water	20	10	10	10	20	10	10	20	10	10	10		10		10			6	5		10		9	10	10	25	15	4
Medicine	3	3	3	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	3	3	2	2	2	2
Total solids	13	21	18	21½	22	23½	23	16¼	20¼	18¾	23¼	20¾	20¼	18¼	21¼	23¾	21¼	16¾	20¾	20¾	22¼	60 gr. 15	17½	21½	18	16	16½	19
Total fluids	59	49	59	58	68	58	58	42	46	48	48	48	58	41	52	42	42	49	53	32	42	27	47	58	47	67	47	41

The lessened appetite, but more particularly the lessened quantity of food, is thus a result of the disease, and does not even then appear to result from any unusual condition of the alimentary organs, considered apart from the general symptoms.

I have not found, in a majority of phthisical cases, that there is intolerance of any article of food except fat. This is part of a subject yet under inquiry; but it is impossible to fail to notice the vastly greater frequency with which this occurs in phthisis than in bronchitis, and to believe it to be highly probable that it is more frequent in phthisis than in health. In many instances there was an intolerance to fat from birth; but in many others it began about the supposed period of origin of the disease. But in no case is this intolerance absolute; for I have scarcely met with a case in which butter is not taken. In most cases suet can be taken if made into puddings, and bacon fat can be eaten when beef fat would be rejected. Many of the cases, too, which reject ordinary beef fat, will take cod-liver and other oils; and hence it is scarcely possible to affirm that this intolerance is because it disagrees with the system, or perhaps because the system does not need fat. Moreover, I have constantly found that if I direct suet in increased quantity to be eaten in puddings, or in milk, if given judiciously and in moderation, it is well borne, and the patients often improve upon it. There can be, I think, but three reasons for the rejection of any articles of food: first, a distaste simply; second, because it disturbs the digestion; third, because the system does not need it: and hence I can only refer the rejection of certain articles of fat to the former reason, and believe that it is in some measure the result of prejudice, and amenable to training.

There is, however, one reason which I have discovered, and which, perhaps, may have value, viz., that all fats lessen the quantity of respiration and increase pulsation, and hence would theoretically be generally contra-indicated in phthisis; and consequently Nature, with her well known wisdom, sets up a distaste for it. This would, however, apply to cases and stages separately and not universally, and would, perhaps, not at all apply to the night, when the rate of respiration is increased, and of pulsation greatly decreased (diagram ii).

Wasting. This is a leading feature of the disease in its advanced stages, but at first it is not so easy as might be supposed to connect it with the disease. In health, the weight varies much in many persons, and the effect of even slight temporary causes of almost any kind, whether bodily or mental, in lessening the weight of the body, is notorious. On the other hand, in many instances of early phthisis there is no change of weight that can be determined, either because it does not exist absolutely, or because the patient is normally spare. The best guide is, perhaps, its duration; but in multitudes of persons in the earliest stage, either the loss of flesh occurred so long previously as to be disconnected with the present attack, and has left a continuing spareness of habit, so that the present habit is considered to be that of health, or there has not as yet been any change in that direction. To what is it commonly owing? Not to want of food, nor to deficient digestion, nor to excessive excretion. It must be referred to one or both of two causes: first, the lessened respiratory changes which have resulted in imperfectly elaborated aliment; and, second, the increased rapidity of circulation, which prevents deposition and facilitates absorption. In individual instances there may be other causes, viz., lessened appetite, lessened quantity of food, vomiting, purging, or some acute disease. It is a question as to how far a diminution in the quantity of fat food which occurs often in phthisical persons may be a cause of the wasting, either universally or in particular cases, since it has been affirmed that in the absence of sufficient respiratory food supplied to the system, the fat of the body is made fuel for the fire; and in all cases of wasting, the fat in the areolar tissue is the substance which first disappears. We have above considered how far fat is deficient in the food, and I believe there are strong reasons against the belief that in cases in which it is deficient its presence would give rise to indigestion, and hence that absence is proof of its want of due assimilation. But if it were so, how can a supply of fat under another form meet the difficulty, since if nature rejected fat food because it was injurious, we should not appease her by increasing the quantity of it? One kind of fat may be better tolerated than another, but some fat which is tolerated is always taken in food in phthisis, but whether to a sufficient amount cannot be proved. There is, however, an abundance of other hydro-carbons in the food, as in vegetables, beer, and spirituous liquors.

Wasting is often temporarily arrested.

Indigestion. Indigestion is often present in the long course of so chronic a disease, but it is not a necessary cause or consequence. It is, moreover, usually amenable to treatment; but yet it oftentimes requires attention. It is commonly associated with a sense of weight or tenderness over the region of the liver on both sides, and indeed this latter occurrence attracts more attention than the former. The condition of the liver is one of lessened action, perhaps, but certainly one of congestion, and it is due doubtless to the interference to the pulmonic circulation which necessarily occurs in the disease. In like manner there is commonly some disposition to deficient action in the bowels, due partly to the same cause as evinced by the occurrence of hæmorrhoids, and subsequently of purulent collections about the rectum. The state of the stomach, liver, and bowels, requires inquiry and relief, since it is so constantly associated with conditions of the throat, and is apt to react in other ways upon the general system; but the continuance of a sufficiently good appetite is the best proof that this state is not constant, and does not seriously interfere with the constitution of the body. It is however so frequently associated with other evils in a long course of disease, that the Physician should have it continually in his view.

Feeble muscular power. Lessened muscular power is due to two causes, viz., lessened cerebro-spinal nervous influence, and defective nutrition of the whole system. The former is easily explained as a part of the general state of system, and is probably always an earlier condition than the latter; whilst the evidence of the latter is the pale and flabby state of the fibre and oily degeneration which is evident within the sarcolemma. There is nothing in this condition which is peculiar to phthisis, except perhaps in reference to the inspiratory muscles; but in every case of chronic phthisis, a degeneration of every highly organised tissue in the body may be demonstrated. In the early stage of phthisis the condition is either non-existent, or it is remediable through the general system.

Hæmoptysis. Hæmoptysis has been held to be an important diagnostic mark of phthisis, on account of the almost infinite frequency with which it is met with in that, over every other disease, and although the disease itself is vastly more frequent than other chest diseases, it is probable that hæmoptysis occurs in phthisis in even a greater ratio. Still, it is equally certain that many cases of phthisis occur without hæmoptysis, even when there are large cavities and extensive softening; and also that hæmoptysis occurs frequently even in health, and in bronchitis, and in any condition in which cough with irritability of the throat is even a temporary evil. Hence, although it may be true that with hæmoptysis the chances are in favour of the presence of phthisis, that gives us but little help in determining if the average apply to an individual case under examination. There is an evil in giving prominence to a secondary and non-essential symptom in the diagnosis of a disease, and it is the less needful in phthisis that that disease has essential evidences, the detection of which is not usually surrounded by much difficulty.

The hæmoptysis in phthisis is due to some or all of the following causes:

Firstly, a diminution in the movement and volume of the blood in the lungs, proportioned to the diminution in the expansion of the thoracic cavity, and of the air cells on which the pulmonary capillaries ramify. This will doubtless exist at any early stage, and by disturbing the balance of the circulation, induce congestion both in the lungs and in the systemic organs. It will, however, be modified by the increased rate of the respiration and pulsation, since by that artifice the tendency to congestion is more or less avoided.

When tubercle has been deposited, and certain portions of the lung have become useless, a larger quantity of blood must pass through other portions of the lung, and hence these will be liable to congestion. Until the process of softening has set in, the hæmoptysis will be due either to capillary transpiration, or to the rupture of the smallest vessels; and hence will generally be small in quantity. I have, however, met with many instances of considerable hæmoptysis, in which no spot of softening could be detected in any part of the lung. In the tubercular stage without softening or inflammatory action, the source of the hæmoptysis, if in the lung, will usually be in the more tuberculous portions. It is, however, quite certain that the most frequent source of hæmoptysis in the early stages is the mucous membrane about the fauces, and in the capillary system of the bronchi; and this may well be so, since at that period the congestion will rather be in the veins of the systemic circulation, and the exciting cause chiefly operates there. It is a most frequent occurrence to find with hæmoptysis in the early stage a state of general injection of the fauces, and minute coagula lying upon the pharynx.

The determining cause is that just mentioned, viz., the congestion resulting from a disturbed balance between the two circulating systems; but the exciting causes are various. The most frequent is doubtless cough, whether induced by reflected nervous influence, or resulting from an increase of the local hyperæmia, itself the product of cold; and any one who will take the trouble to notice in his own throat the violent faucial efforts made in that act, will find no difficulty in accounting for the transpiration of blood or rupture of minute vessels. The cause is often thus localised and very manageable; and it is especially localised in cases resulting from inhalation of hard particles, as by dry grinders, stone cutters, &c.; but in them it is not very manageable. It may also be due to more distant influences, as want of due freedom of circulation in such systemic organs as the liver, or of due excretion from the kidneys or bowels.

Secondly, to the rupture of the larger pulmonary vessels, as is more particularly met with in extensive softening, and also in cavities, where a vessel which previously had been opened during the stage of softening had subsequently been temporarily closed by a coagulum. It also occurs from the gradual withdrawal of the surrounding and supporting tissue, so that at length the vessel traverses a cavity, and with degeneration of tissues proceeding, it ultimately gives way. It is to these latter causes chiefly that the final hæmoptysis is due, which suddenly ends the disease and the patient's life together. When we consider the very small space in the lung which is left for the pulmonary circulation, and through which all the systemic blood has oftentimes to pass, it is a matter of great wonder that fatal hæmoptysis does not more constantly occur, and that at an earlier period. The expedient of increased rapidity wards off the evil for a time; but that also must fail. It is probable that the secret lies in the fact of an opening in the septum auricularum being a common occurrence in phthisis, (as I have often seen in our *post mortem* room), by which a certain portion of the blood from the right side is directly passed to the left; and it would be a most interesting inquiry to determine if fatal hæmoptysis, not associated with destruction of vessels in a large cavity, does occur more frequently without than with this safety valve in the heart. I doubt very much if we are entitled to assume that the body always retains an uniform quantity of blood, and it is more than possible, from vital as well as *post mortem* evidences, that in the advanced stages of phthisis it is diminished; and hence this, too, may tend constantly to prevent the fatal rupture.

Other hæmorrhages. The occurrence of *epistaxis*, of *hæmorrhoids*, and of *menorrhagia*, in the early stage of the disease, may be explained on the foregoing grounds of disturbed balance of the pulmonary and systemic circulation, and the venous congestion of certain portions of the latter. The former is also commonly associated with violent respiratory efforts.

Pallor of skin. The diminution in the colour of the skin, either entirely or in parts, is not peculiar to phthisis, and is not always present in its early stages. At a later period, as in that of every other chronic disease, it certainly occurs; but it is more particularly found in persons of sensitive and sanguine temperaments, disposed naturally to roundness of form. Speaking generally, it must be due to that very ill-defined condition, "defective nutrition;" and, to speak more particularly, it is said to be much owing to a diminution in the quantity and to a change in character of the red blood corpuscles. It is not presumed, I believe, that this change in the red corpuscle is peculiar to phthisis, or that it is otherwise associated with it than as usually from long continued interference with nutrition. I think it probable that a diminution in quantity does really exist, and that is rendered the more so by the special interference with the function of respiration, which is the essence of phthisis. If the red globules be oxygen-bearing bodies, and that only, then, as less oxygen must be admitted into the blood when three-fourths of the lung is unfit for duty, it would be a reasonable assumption that fewer red corpuscles would be required.

Flush of cheek. I know of no satisfactory explanation of the flush upon the cheek, which is so frequent at certain stages of the disease, and which is so nearly restricted to that locality. If we knew the precise reason why blushing should select that locality, or why in health more colour should often be found there than in other parts, it might aid us in this inquiry. To answer that it is owing to fulness of the vessels at that spot, is to give no answer to the question, unless it could, at the same time, be shown that the capillaries or small vessels are more abundant and are larger in that place than in any other, or that they have a more superficial position, or that there is a power of determining the blood to that part, which can be demonstrated. My excellent colleague, Dr. Thompson, has made this a subject of inquiry; but without result, I believe: yet he has ascertained that it is not necessarily due to the patient having lain upon that side, nor to the side on which the pulmonary softening is proceeding.

Rate of pulsation and respiration. The rate of pulsation and respiration in phthisis is most variable. In the inquiry before referred to, I found that that of the former varied from 55 to 166, and of the latter from 11 to 43, per minute; and that the total average of 3,000 observations in all stages combined, was 95·3 pulsations, and 23 respirations, per minute. In one-third of the cases there was a total average pulsation under 90 per minute, and in only one-third did it exceed 100 per minute on the total average; whilst in one case, with phthisis of both lungs, and also with Bright's disease, the total average was 76·1 pulsation per minute. The highest monthly average recorded was 128·4 per minute. The highest average rate of respiration was 31, and the lowest 16 per minute (diagram iv, and the *British and Foreign Med.-Chirurg. Review*; April, 1856).

The ratio of the two functions was also equally variable. In individual instances it was as low as 1 to 9. The ratio of the total averages varied from as 1 to 3·3 to as 1 to 6·2, and even in the same case the ratio varied with the day and night from as 1 to 2.8 to as 1 to 5.1. In a woman, the ratio at one and three a.m. was found so high on the average as 1 to 1.4 (diagram ii, and the *Transac. of the Roy. Medical Society*; 1856).

Hence, increased rapidity of both functions is commonly associated with phthisis, but, except at the last periods, it is not invariably present. In the advanced cases there was found not only increased frequency, but greater variation in the rate, and also greater excitability of system. There was a *general* relationship between frequency of respiration and extent of disease, frequency of pulsation, short stature, lessened vital capacity, and excitable temperament. Posture was powerful in modifying the rate in phthisis; so that there was an extreme excess in one day of 29 pulsations in the sitting over the lying posture, 32 pulsations in the standing over the sitting, and 44 pulsations in the standing over the lying posture. The total extremes recorded were—lying, 55 and 138; sitting, 62 and 150; and standing, 75 and 166; whilst the total average was a difference of 10 pulsations between each of the postures in the morning, and 7 in the evening, or a total of 20 pulsations between lying and standing in the morning, and 14 at 4 p.m. (diagram iv). Increase in the rate of pulsation, from posture, is not invariable, but in one-fifth of the whole observations there was an increase in the sitting over the lying, and in 237 of 502 observations, there was an increase in the standing over the sitting posture. The total average showed an increase of 1 per minute in the sitting, and 1.4 per minute in the standing posture.

The influence of day and night is very great, but during each of these periods separately, there was much uniformity (diagrams ii & iii). The periods of change were the morning from five to ten o'clock, and in the evening from nine p.m. to one a.m.; and the total average of the increase was 27 pulsations in the former, and the decrease 19 pulsations in the latter. In isolated instances the increase of the day over the night was upwards of 40 pulsations per minute. The low pulsation of the night was due to, first, posture of body which has been given above; second, darkness, about 10 pulsations; and, third, sleep, from 5 to 10 pulsations on the average. The higher pulsation of the day was associated with, first, waking from sleep, 5 to 10 pulsations; second, sunlight, 10 pulsations; third, food, viz., breakfast, 10 pulsations; dinner, 11 pulsations; tea, 7 pulsations; and supper, 2½ pulsations: fourth, exercise and mental actions and emotions. The influence upon the rate of respiration was in some respects different from that in the rate of pulsation. The total rate was higher in the night than in the day. This was associated with sleep, and so great was the influence, that with the first hour of sleep there was often an increase of 10 or 12 pulsations per minute, and with the first hour of waking in the morning there was a total average diminution of 13 respirations per minute. The lowest rate of the 24 hours was observed at the time of waking in the morning, and before food had been taken. Sunlight appears to have no influence over the rate of respiration; but temperature, in the long period of one month, greatly increased the rate of pulsation, and lessened that of respiration. With this increased temperature was also commonly associated increased dryness of the air, and hence both causes might have operated to produce the opposite effects just mentioned. Food increases the rate of respiration to the extent of 2¼ respirations after breakfast, 3 after dinner, and 1½ after tea; but the effect of supper was too frequently null to be estimated by averages.

Hence, in estimating the rate of pulsation and respiration in phthisis, we must have regard to the following circumstances: age and sex, stature, temperament, extent and stage of the disease, posture of body, exercise, wakefulness, sleep, sunlight, darkness, temperature, humidity, and food.

The quantity of air respired was determined by a subsequent investigation, to which we cannot now refer, except to state that in health it bore a general correspondence to the rate.

To what is the increase in the rate of these two functions over that of health attributable? In many diseases, as in fevers for example, it would be impossible to give a satisfactory answer to this question; and even in inflammatory diseases, in which the explanation seems the readiest, it is not so easy as it appears to be. But it is probable that during the largest part of the existence of phthisis, the increased rate of pulsation and respiration is due to neither of these conditions. The rate is doubtless determined by the necessity, or at least by the call, for respiratory and assimilative changes, and by the response, which the lungs and heart are able to make to that call. There is no evidence that this increased rate precedes the early stage of phthisis, but rather that it is an effect of the conditions met with in the earliest stage, and, in fact, that it is due to them and will be proportioned to them. If the requirements of the system demand that amount of respiratory change which is ordinarily furnished by healthy lungs with their normal volume and the normal degree of expansion of the thoracic cavity, it is manifest that if those changes must be given when the capacity of the lung both to receive blood and air is lessened, the action of the remaining portion of the lung must be increased in proportion to the diminution in the action of other parts of that organ. In phthisis, even in its earliest stage, the capacity of the lung for the reception of blood and air is reduced; and hence, other conditions remaining the same, the amount of vital changes must be reduced. It is probable that this, in fact, does occur, and that with it there is a more feeble call for these changes in the intimate processes of the system; but as the lessening of the call is not in proportion to the lessening of the power of response, nature submits and partly makes efforts to overcome it. This varies in individuals and in the stage of the complaint; so that although increased effort is made, the system yet suffers.

In what manner then could nature increase the functional efforts of the remaining portion of lung, but by increasing the *frequency* of the action, seeing that we know nothing as to the variation in the intensity of these actions in every part of those organs?

Hence, she produces increased results from a small portion of the lung, by introducing and withdrawing the air more frequently, and by increasing the rapidity of the blood current. The former seems to be a direct, whilst the latter is an indirect action; for as the lungs are enabled only to forward a lesser quantity of blood to the heart at a time, the cavities of the heart will be less filled: and hence, as well as by the necessity of the system for the circulating fluid, that organ must act more frequently than in health. There must be a relation maintained between these two functions, no matter how much they may be severally deranged from a state of health: for a disproportionate action would, on the one hand, cause congestion of the lung, and on the other, a deficient supply of arterial blood to the system.

Thus, when the lessened action of the lungs has proceeded to a certain extent, a reaction is set up and exhibited in the increased rate of pulsation and respiration, and without this the case would inevitably terminate fatally at an early period. So far, then, it is clearly a conservative action in the system, and ought to be encouraged; not however by such processes as are known to quicken the circulation and respiration, but by such as are known to increase respiratory changes: and by so doing we should, if it were possible, lessen the frequency of both functions.

When the increase depends upon temporary causes, as for example inflammatory action in the lungs, and pleura, or similar changes in other parts of the system, it is clear that special attention should be given to it; but whatever may be its immediate cause, it necessarily follows that there will be a tendency to venous systemic congestion on the one hand, and deficient arterialisation of the blood on the other; and thus disease and defective nutrition will go hand in hand with the diminution of the vital capacity of the lungs.

There is yet another cause for this increased frequency, viz., the presence of a superabundance of aliment in the blood; for if it be true that the quantity of nutriment which is taken into the system is not greatly diminished until an advanced stage of the disease, whilst at the same time the digestion is good but the capability of performing the required changes upon the nutriment is lessened, it follows that it must be imperfectly elaborated and thin, but it will be less fitted to sustain the system. This end can only be obviated, partially or wholly, by the repetition of the exposure of the nutriment more frequently than in health, through the increased rate of the blood and air current.

Blood. Much has been asserted, and but little proved, in reference to the changes in this fluid, and consequently we need not give an extended reference to it.

First, in reference to the quantity of blood: are there not grounds for the belief that the quantity of blood in the body changes with varying conditions of the system? It seems to me that as it is replenished by alimentation and diminished by assimilation, deposition, and excretion, it must vary in health at every moment; and in proof of the former, I would instance the condition of the pulse after imbibition of nutritive fluids, and the marvellous change which has so often been proved to follow the injection of water, &c., into the veins, in cases of cholera, where the quantity of blood had doubtless been vastly reduced by the enormous excretion into the bowel. Moreover, as the body increases and decreases greatly in bulk and weight, there must be a similar change in the quantity of the nutritive fluid. In phthisis, I think, there is proof beyond these, in the exsanguined condition of all the parts which may be observed during life, and after death by the absence of the usual amount of congestion in the great vascular organs in the body, and the smallness of the quantity of the blood clots found in the blood vessels. This change is not, I believe, to be accounted for by stating that the diminution in the colour of the blood renders it less perceptible, and that the diminution of the quantity of fibrine permits an unusual amount of *post mortem* transudation; but I venture to affirm that the quantity of blood is really lessened, and that in phthisis as in health it is erroneous to state that a fixed and uniform quantity of blood exists generally amongst men in health and in disease, or in the same individual at various periods.

It is not an easy matter to account for lessened quantity in states of wasting in phthisis, since I have proved, on the one hand, that the quantity of nutriment, both solid and fluid, which is then taken is not greatly diminished; and, on the other, that until an advanced period, if at all, the excretions are not increased: and in reference to deposition it is evident that that is lessened so far as regards the whole of the body, and is increased only in the deposition of tubercle, if tubercle be a deposition at all. Hence, the supply being equal and the waste not increased, how can we account for the diminution in the quantity of blood, as a resultant condition of phthisis? The only direction to which we can look for an explanation is the relation between the pulmonic and systemic circuits, and that is rather in the direction of final causes, about which we can reason but little. There must be a relation between the quantity of blood in the whole body and the possibility of its passage through the pulmonic circuit; and if from any cause the latter is hindered, there must be an increase in the rate of movement or a diminution in the quantity to be moved, or otherwise the impediment would extend to the systemic circuit, and lead to congestion and extravasation. The latter is the result of any sudden interruption to the pulmonary circuit; whilst in phthisis, with its slow increase of obstruction, the quantity of blood in the system in some degree approximates to the lessened capacity. It must be manifest that with the vascular ramification in the lung, so greatly reduced as it is in extensive tubercular deposition, either the original extent was unnecessarily large, or the existing degree is disproportionately small.

By this mode of reasoning, however, we do not get beyond the mere statement of the occurrence, and have to rest contented with the general truth that Nature adapts her requirements to her circumstances. I do not think it possible to demonstrate the number of pounds weight of blood which exists in the body in phthisis. If, however, the fact of the diminution in quantity be admitted, we shall be entitled to the further inference that the quantities of the component parts are lessened in the same or in some other ratio, and that its capacity for the performance of certain duties, as those of deposition and the conveyance of gases, must be lessened; and hence that nutrition and every other function due to the circulation of the blood, except the rapidity of its movement, must be lessened also, and probably to a degree which is inconsistent with the well being of the system.

Secondly, as to the quality of the blood. Since the quality of this fluid is in part due to the influence of respiration, it is impossible to conceive of a diminution in the quantity of blood as a consequence of lessened capacity of the lungs, without a change in the quality of that fluid. The influence of respiration in the elaboration of the blood is not perfectly known; but the following circumstances at least must have a relation to the due influence of respiration:

1. Changes in reference to the quantity and quality of the fibrine.
2. The transpiration of aqueous vapour.
3. The transpiration of peculiar matters.
4. The evolution of carbonic acid.
5. The decomposition of the air and the absorption of oxygen.

When the function is decreased in extent, it may be presumed that all its effects would decrease also; and hence that aqueous vapour, effête matters, and carbon, would be unduly retained, whilst the absorption of oxygen and all its effects produced in and through the blood would be lessened.

The determination of the precise extent of these changes upon the blood is yet a desideratum. The red corpuscles are said, and with probability, to be decreased in quantity, and also that they are changed in figure; but this demands further proof. The quantity of water and of fibrine has been proved by Lehmann to vary with such temporary conditions as inflammation and sweating, and the quality of the fibrine is believed to be lowered from the disposition to hæmorrhage which is said to exist.

As to the existence of any specific elements of disease in the blood, either necessarily causative of phthisis or peculiarly due to it, much is asserted and nothing known or demonstrated.

I cannot leave this subject without expressing an opinion that it is desirable to determine if any peculiarity exists in phthisical persons in reference to the dynamics of the circulating and respiratory system. The law that circles are to each other as the squares of their diameter, shows how imperative it is that the divisions and subdivisions of a tube should collectively be much larger than the trunk, and as Nature exhibits anomalies in all her works, it is of great moment to determine if such exist in this direction in a disease which exhibits so great a diminution in the capacity of the peripheral subdivisions of some of the conduits.

Perspiration. The readiness to perspire which is often found in phthisis is not peculiar to the disease, and is moreover commonly an effect of anterior conditions of the disease. It is doubtless due to a state of less tonicity of tissue and increased nervous susceptibility, and will be most constant when the blood is impoverished. When it is found more particularly with sleep, whether by night or day, it is attended with a low state of pulsation, and especially so in the night, and then more than at other times is due to lessened vitality of system. It would also be open to inquiry if this increase is not in some degree vicarious; for whilst there is commonly much fluid taken into the system, much less leaves the body by the lungs than occurs in health, and hence the quantity by the urine and skin should be vicariously increased.

Diarrhœa. Diarrhœa is not more frequent in phthisis than would have occurred in the same period in health, except at the latter stages of the disease. So far as it belongs to phthisis, it is not idiopathic, but results on the one hand from a general systemic congestion, or from local inflammatory action. Hence, whilst its continuance is often most prejudicial, its sudden arrest would be equally so, and must be brought about by indirect rather than by direct means. In the former condition it may be relieved through the liver, perhaps; but from its nature it is not so amenable to treatment as when it arises in health from accumulation of fœcal matter or alvine secretions. When it occurs under these conditions in a moderate degree, it often tends greatly to remove its cause.

Chest pains. Pains in various parts of the chest are very varied in their seat, duration, and severity. There are three positions in which they are commonly met with, viz., below and at the apices of the scapula, in the side, both in the lower ribs and in the abdomen, and a little below the clavicles. The character is rather that of severe aching rather than lancinating, and is not infrequently increased on motion. It is distressing without being acute, and without any evidence of inflammatory action, and is evanescent and recurring. I think there can be no doubt that these pains are situate external to the pleural cavity, and that they are in the muscular or tendinous structures. From the position of the pains, the site seems commonly to be at the point of origin or insertion of muscles, and therefore to be rather tendinous than muscular; and this is more particularly the case with the origin of the diaphragm from the cartilages of the ribs, and with the digitation of the external oblique and the serratus magnus: but in other instances it is referred to the body of a flat muscle, as that of the external oblique. The pain, too, which is situate about the region of the clavicle, is evidently associated with the subclavian muscles, and also with the pectoral muscles.

The nature of this pain is not known. In some instances it may be inferred to be rheumatic, since it obtains great relief from the acetic extract of colchicum: but, unlike rheumatism, it is not increased in the night, nor dependent, I believe, upon conditions of the weather. It would be a point of great interest and importance to pursue closely any investigation as to the precise muscles in which it is usually found, and particularly to ascertain if it affect chiefly the muscles of inspiration, and is associated as a cause with the lessened power of those muscles. I believe its nature to be peculiar and similar to that pain found so frequently in the side of nervous persons, and which is so commonly intractable. I do not think that there is evidence to show that it is essentially associated with pleuritic adhesions.

Pleuritic pains are common, but do not call for particular description, as also the inflammatory pains so frequently met with in the small intestines in the last stage of the disease.

Mind and nervous system. The state of the mind is unaffected throughout nearly the whole course of the disease; and it is very striking to see a patient, reduced by great emaciation and with great destruction of even both lungs, able to attend with calmness and with sufficient power of mind to his ordinary concerns, and to go through a long course to the very edge of the grave, with intellect clear, and with muscular strength sufficient to enable him to walk about. In states of great exhaustion, and especially in the night, when vital functions are at their ebb, and in persons of certain temperaments, delirium is occasionally present; but it is a state usually temporary, and one from which the patient may be withdrawn. It is far more common to see the sufferer panting for breath and borne down by exhaustion, whilst the mind is yet calm and clear, and to hear him converse with tolerable cheerfulness, the day or almost the hour before his death. Certainly, the mind is that which retains its power later than any other part of the individual. There is said to be a placidity and amiableness about such persons which is absent in other chronic diseases, and that they are more than ordinarily open to religious influences; and I believe that the experience of a hospital confirms that statement: but I have met with others who have been morose even to the last, as well as others who have exhibited very great mental excitement and dread. This may in part be referable to their natural disposition, but not by any means is it entirely so. It is in great part a feature of their disease.

In reference to the nervous system apart from the mind, I think that experience sustains the assertion that there commonly is exalted sensibility and increased activity; conditions which are commonly, perhaps, natural to the system in which they aro then found, and which increase with the debility and the increase of the disease. The proportionato liability of similar systems to the disease, is unknown; as is also any especial liability of the respiratory tract, or other portions of the nervous system. Both are interesting but untrodden paths of inquiry.

PART II.

PRINCIPLES OF TREATMENT.

Having now indicated in outline some of the leading vital conditions of a case of phthisis and the principles on which they may be explained, we proceed to point out the method of treatment which may be legitimately deduced therefrom.

Essential feature is lessened respiration. It has been proved that the essential feature of phthisis is lessened action of the lungs in general, and of the air vesicles in particular; and that this is both a cause and an effect of the disease. It has also been shown that, as an essential cause, it is not induced by any obstruction within the lung, such as that of deposited matter, nor by any other circumstance which in its nature is irremediable. Hence, up to a certain point, phthisis must be regarded as a curable disease, if placed under circumstances as favourable for a cure as are required for the cure of any other disease. This period certainly extends over what I have termed the first or the pre-tubercular stage; but whether the limit ends precisely with the termination of that period cannot be positively affirmed. The experience of the profession and of mankind has abundantly proved that after a period the disease is commonly—we might almost say universally—incurable, and that not from any quality of malignant destruction, as by ulceration or mortification, but from increasing encroachments upon the vital capacity of the lung; whereby so essential an organ becomes less and less enabled to perform its functions. The stage of destruction does not do further mischief in this direction; for only that part of the lung is destroyed by softening which has already become useless by reason of the deposition of solidified matter; and although destruction may be injurious to the system in some instances, by leading to the absorption of unhealthy matters into the blood, and in many others by inducing effusion of blood, I do not think that there is evidence to prove the former to be a common circumstance. Hence, we cannot regard the stage of destruction to be an essence of the disease; for it arises simply out of prior conditions, and adds nothing original to the morbid processes.

It is true that in some degree a similar mode of reasoning might be applied to the stage of deposition, for that is due to an anterior condition of lessened respiration, which is truly the essential feature of the disease; but there is this difference—that the deposition or accumulation of material is a new process in the course of the disease due to, but in nature distinct from, the preceding condition. Thus the essential part of phthisis is the lessened respiration ; but that alone, would never, so far as we know, induce death ; whilst tubercle is a new order of things, due to and supervening upon the former state. The final stage is one of transformation only of the new deposit, and is associated with destruction of lung; not from any destructive process which began in the tissue of the lung and extended to the deposit, but because the removal of the deposit permits the disintegration of the tissue containing the deposit, and which has not vitality sufficient to retain its form when the support from the deposited matter is removed. The softening of the tubercle is thus an accident, as is still more the breaking up of the lung tissue, although the low state of vitality of the system, which is necessary to both processes, may commonly occur in the progress of every fatal case of the disease. There can be no doubt that the disease may be, and has often been, arrested in either the first or the second stage, and yet it was as much a case of phthisis as if it had gone on to that of destruction. I am anxious that the distinction which I have here attempted to make should be understood, for, so far as I understand the disease, it is the filling up of the lung, and not the destruction and removal of it, which is the important feature of the case ; and on good physiological grounds there is reason for affirming the latter to be a beneficial, and the former a fatal condition, notwithstanding that their order of sequence seems opposed to this statement—except, indeed, when the former induces pyæmia or serious hæmorrhage, both of which are accidents in the fullest sense of the term.

Hence, the inverted order of sequence of these phenomena will be as follows : First, death, due to—*a*, hæmorrhage (fatal) ; *b*, pyæmia ; *c*, exhaustion. Second, hæmorrhage, pyæmia, and exhaustion, in part due to destruction and softening. Third, destruction, softening, and exhaustion, in part due to the accumulation of tubercle and to lessened vital processes. Fourth, tubercle and lessened vital processes, due to lessened inspiratory action of the air vesicles of the lung. And, fifth, lessened inspiratory action of the air vesicles, due to some of the conditions mentioned under the head of shortness of inspiration.

From this it follows that the essential or curative treatment must be applied in a stage prior to the fourth just mentioned, unless we have the power of reducing the condition of the ulterior stages to those existing in the curative stage. In reference to the latter alternative, I know of no power which we possess and can exert in a definite direction and on known scientific principles to bring about this end. Theoretically, tubercle may be expectorated, but practically it is not all expectorated ; neither is the continuance of the deposit arrested ; but, on the contrary, the deposition of tubercle by filling cell after cell tends to the production of further deposit by arresting the action of adjoining cells (at least within the same lobular membrane), and hence the deposition continues. So, in like manner, theoretically the softening of tubercle facilitates the process of expectoration, and the destruction of the diseased lung tissue permits the healthy adjoining tissue to expand, and the walls of the emptied space to approach each other; but, practically, the softening and destruction do not do this generally, and do not hinder the further deposition of tubercle in other parts of the lung; and as the removal of diseased matter and effête tissue removes a certain portion of these organs, whilst no new tissue is formed and new deposition continues, the disease is not arrested.

I think it might be proved that the disease may be *arrested* in any stage, but hitherto experience has shown that although medical aid is probably sought in every case, the cases die, and hence, that our art commonly fails; and that when it succeeds it is chiefly under circumstances which are unknown to us; and therefore cannot be reduced to laws, and applied with certainty to other cases. Hence, I fear, that our art obtains alike unmerited credit and disgrace.

I have entered into this argument to warrant me in earnestly calling attention to the first or pre-tubercular stage, since in that and in no other we have every physiological reason for believing that our efforts may be effectually and rationally made.

Essential treatment is to increase respiration. The principle of treatment in this stage is very simple, and is generally of easy application. It is the increase of the action of the whole lungs; and hence of the air vesicles of those organs; for it is to their special elongation by the entering current of air that the enlargement of the capacity of the thorax is due.

This may be effected by many aids; but it is of importance that if the rate of pulsation be already too great, those remedial measures should be preferred which will increase that rate as little as possible.

Voluntary deep inspiration. The first of these, and undoubtedly the most perfect, and at the same time the most difficult in its continued application, is that of deep voluntary inspirations, to an extent far greater than that ordinarily effected by the patient. This may be effected by appropriating ten minutes at *convenient* periods twice or thrice a day, and by inspiring *slowly*, but, to the utmost degree, taking care that the chest is placed in a good posture, the mouth open, and the larynx also open, so that the patient may feel the current of air passing down the throat; and taking care further, that on the one hand there is every possible inspiratory effort employed at the end of the inspiration; and on the other, that the effect corresponds with the effort. The chief difficulties with which we have to contend are—1st, quick inspiration, which expands the air within the lungs, and does not obtain so much from without; 2nd, apparently inspiring, when, in fact, the larynx is closed, and no air is entering; 3rd, the belief by the patient that he is using sufficient effort, when, in fact, the power employed is very feeble or has ceased; and, 4th, the absence of that watchfulness which is needful, in order that the patient may continue to make the voluntary inspirations effective. The advantages are, that the air inspired will have increased from—say 20 cubic inches to 100 cubic inches per inspiration—a circumstance which will increase the evolution of carbonic acid, and therefore all respiratory changes; and will distend the air cells in an unwonted degree. The muscular power will also be increased by continuance of the effort.

Exercise. My recent experiments upon myself have proved that walking in health at one mile per hour increases the respiration from 500 cubic inches to 800 cubic inches per minute; at two miles per hour, to 1,000 cubic inches; at three miles per hour, to 1,600 inches; and at four miles per hour, to 2,300 cubic inches per minute. Whilst with running moderately, at six miles per hour, it is more than 3,000 cubic inches per minute. The depth of inspiration is likewise increased from 35 cubic inches to 100 cubic inches per respiration; and hence both the mechanical distension of the lung and the chemical and physical changes of respiration are greatly increased. It is most important to bear in mind that gently walking, at two miles per hour, will fully double the quantity of air inspired.

Riding in a carriage increases respiration, but the degree varies with the oscillation of the carriage. In an omnibus the increase is fully half of the original quantity. On horseback at the walking pace, the increase is more than half, in trotting three and a half times, and cantering three times the original quantity.

All athletic exercises are most powerful. Thus, the carrying of weights at three miles per hour increases the quantity of air inspired per minute, at the rate of 7½ cubic inches for every pound weight carried. Hence, bowling, throwing of weights, climbing, wrestling, running, jumping, and dancing, all increase the quantity of air inspired from double to seven times the original quantity, and in a proportionate degree the depth of inspiration. One hour of walking, at three miles per hour, would be equal to more than three hours of quiet sitting, in reference to the quantity of air inspired; whilst half of an hour of running, at six miles per hour, would be fully equal to the same quantity. One hour of riding in an omnibus or carriage, if not of easy construction, is equal to about one hour and three-quarters for the like purpose; and one hour of riding on horseback, at a walking pace, is equal to one hour and three quarters; at a canter, to three times; and at a rough trot, three and a half times the quantity with quiet sitting posture. It is then easy to estimate the amount of oxygen which would be inspired by persons undergoing any amount of exercise per day. Thus, if a person spent each day seven hours and a half in the lying posture, breathing 480 cubic inches per minute; six hours in the sitting posture, breathing 533 cubic inches per minute; three hours in walking, at three miles per hour, breathing 1,800 cubic inches per minute; and four hours in standing and walking, at two miles per hour, breathing 1,000 cubic inches; he would breathe 958,380 inches per day, and inspire 72,292 grains of oxygen. The numbers of cubic inches per minute now given are those which I breathe, and are doubtless greater than in the first stage of phthisis; but the importance of exercise will not be less apparent in phthisis than in health. There is nothing, in my opinion, which would be of greater benefit in this stage than a due attention to athletic exercises, and especially in the form of games, which would at the same time amuse the mind. I do not doubt that there were moral evils attaching to the country games and sports of former days, and which are now only matters of history; but I am sure that they tended greatly to the invigoration of the body and to the prevention of disease.

It may be objected that many have phthisis who take all the exercise that a man can bear, and breathe therefore as much as a man can breathe; and hence, that in such an one the phthisis could not be due to deficient respiration. In explanation of this fact, we must refer to three others: first, that phthisis is not dependent for its production upon one cause alone, and that but seldom can the influence of one cause act separately from that of others; second, that excess may induce reaction, and consequent defect; and, third, that exercise is not an unmixed good, since, while it increases respiration, it induces a greater necessity for food, which the patient may not be able to supply, and it also increases pulsation; and hence, with increased waste of the system there may be lessened deposition of nutritive material.

The supply of food does not fall within the province of the medical man, neither can it be largely taken into the account in forming a plan of treatment; but the rate of pulsation is a circumstance more under his controul, and one which he cannot overlook. Of all the modes whereby the respiration is increased, there are but two which do not at the same time increase the rate of pulsation, viz., the voluntary deep inspiration and cold bathing; and hence, they are the purest kinds of treatment. Walking at the rate of four miles per hour will increase the rate of pulsation to about 130 per minute; and running at six miles per hour, to about 180 per minute: and even in gentle exercise there is some increase in the rate of pulsation. The degree in which this can be borne, or rather the degree in which the blood can be hastened through the pulmonic circuit, is the limit of the degree and kind of exercise which we can ordinarily take; and it is especially needful to have reference to it in states of disease: but it is not possible to particularise further than by the facts already given.

Reading aloud and singing increase the *depth* of inspiration more than the *total quantity* per minute.

External cold. Cold bathing and washing increase the quantity and depth greatly; the former to double the original quantity. Walking in the water, as in sea-bathing, increases the depth of inspiration to the same extent nearly as in walking at the rate of four miles per hour on land. Swimming increases both the depth and the quantity to the same extent as walking at three to four miles per hour.

Food. Food, speaking generally, causes an increase in the quantity of air inspired; but whether simply by supplying respiratory food, or simply by acting as an excitant of the respiratory nerves, or in both modes combined, is still open to inquiry, both in reference to particular articles of food, and to food in general. The combination of various kinds of food, as in ordinary meals, commonly increases both the rate and the quantity of air inspired, except at supper time, and with light food. The breakfast invariably causes the greatest increase, and the dinner the greatest duration of the increase: the former being due, doubtless, to the previous absence of food for many hours; and the latter to the continuance of some of the effect of the breakfast, and the larger quantity of animal food which is commonly taken at the dinner meal. The increase occurs within about one hour after a meal, and in part disappears in about three hours, or before the next meal; and hence, on a consideration of the foregoing, we infer that the breakfast is the most important, and should be the best meal of the day; and that afterwards, food should be repeated every four hours, and especially in the late part of the day should not be in large quantity. It is evident, from the increase of all the functions in the day, and their decrease at night, that the day is devoted to the primary digestion and assimilation of food, and the night to the deposition of it and the repair of waste; and hence, that food should be given during the day, and withheld at night. In phthisis, however, there are special reasons for administering food in smaller quantities, and frequently both by night and day, viz., that during the day, the expansion of the lungs is still further lessened, if the stomach be distended; and in the night, the subsidence of the functions is so much greater than in health, that the system has too little vitality, and night perspirations supervene, unless food is administered in the very early morning, at the period when the perspirations and exhaustion are the greatest. Hence, I always direct that food be given in the early morning, before the patient rises; and, if there are night perspirations, I have found that (after removing all external causes) an almost certain remedy, is a large cup of good cold tea, with bread and butter, taken when the patient awakes with the perspiration. There is also another reason for the administration of food in the night; viz., as food increases pulsation, it is more fitting in a disease with rapid pulsation, at those periods when the pulsations are naturally the fewest.

In reference to the influence of various articles of food, I have ascertained that all fats, brandy, and wine, lessen respiration; that starch and casein either lessen it or have no effect; and that albumen and gelatine, and particularly sugar and tea, increase it, as also does rum. Hence, other things being equal, tea, sugar, and lean meat are the most important articles of diet for the purpose of increasing respiration; and then such grains as wheat and oats, which have also a considerable effect in that direction. Pure starch, as arrow-root, and even such vegetables as potatoes, which, although having starch as their chief component, have albuminous and other elements, have either none, or only a very small influence in this direction.

In reference to fats, it is, I believe, certain that they are necessary to the system, not from their carbon and hydrogen (which may be supplied from other sources), but from the mechanical effect of minute globules in promoting the secondary changes in digestion. For this purpose, new milk is most suited, since it at once offers the oil in the form which is required. It is highly desirable to determine the quantity of oil which is needful for this purpose, and then to ascertain if the remaining portion of the quantity which is commonly taken in health, might be supplanted by other hydro-carbons; for it is now believed, that in phthisis, there is a greater distaste for fat food than is found in health.

As a rule, it may be affirmed that much of the hydro-carbonaceous food lessens respiration, and hence such are not the most fitting articles of food; but, at the same time, it is equally certain that they are necessary to the system, and must be supplied to it; whilst their effect in this direction is counteracted by the administration of other kinds of food. Indeed, the appetite, as well as the universal experience of mankind, leads to an admixture of the two opposite kinds of food in all meals; and we must assume that this combination is the most fitted for the system.

There are three articles of food which I think it right to single out for inquiry, viz., spirituous liquors, tea, and sugar. I do not understand how the former can be universally beneficial, much less that they can be needful: and as to the latter, it is of importance to determine if it simply excite respiration without supplying food for it; for if it do so its administration must be regulated by that of other articles of food, as starch and fat, which do not excite respiration, and by the excess or deficiency of food already in the system. The large influence of sugar is so remarkable as to lead to the inference that of all kinds of food it is the true respiratory food.

Sleep. Since sleep in phthisis commonly quickens the rate of respiration and lessens that of pulsation, it should be cultivated, and especially by day.

Medicine. Nearly the only medicine which I have yet examined which increases respiration is ether. The medicinal treatment of the first stage is for the most part derivative with the view of preventing congestion of the pulmonic and then of the systemic systems from the deficient pulmonary action. The following are the conditions which require constant watching. The *liver* is apt to become tender and inactive, and with it there is a disposition to constipation of the bowels which may have proceeded so far to have induced enlarged hæmorrhoidal veins. This is, perhaps, the most frequent condition, and is relieved by small doses of blue pill, occasionally, and a frequent exhibition of gentle aperients, as, for example, Corbyn's extract of colocynth. *Indigestion* is not unfrequent, probably from the same cause, and also from the imperfect elaboration of the food by the lungs; but it is but rarely a troublesome condition, and generally submits to the influence of aperients and to regulation in the quantity and frequency of food. It is only so far peculiar to phthisis.

Deficient circulation. Coldness of the extremities is due to the same causes, and is an important evidence of defective peripheral and consequently of excessive central circulation of blood, and it will be a measure of the progress of the case. It is to be relieved by exercise and friction, rather than by the external application of warmth. There is a tendency to a diminution of the *animal heat*, owing doubtless to the deficiency in the vital processes in the system, and hence care is required to protect and regulate it by suitable clothing, and by the temperature of the air which is respired.

Hæmoptysis. Hæmoptysis in this stage must always be due to the condition now under consideration, with or without violent efforts in coughing. It may proceed from any part of the mucous membrane of the respirating tract, but commonly it is from the parts about the fauces, and is perhaps most commonly a transudation. The duty of the physician will not be to administer styptics, which would only tend to increase the congestion, but to induce greater freedom of circulation in the systemic circuit, and particularly by diverting the blood to the surface, and preventing accumulation of it in the large vascular glands. Hence, derivates constitute the only rational remedies.

Cough. Cough is also due in part to this disturbance in the circulation, but it has a local cause in the throat which requires attention. The local remedies have been already mentioned under that head, and in addition to the derivates above referred to, it is needful to employ sedatives. These should be in doses so small that they shall not disturb any function in the body, and either regularly or intermittingly used as the case may require, but always with the proviso that they be given half an hour before the period when the attacks of cough usually occur. Morphia, in doses of one-sixteenth to one-twelfth of a grain, is, I believe, the most successful remedy; and one the effects and properties of which are the most constant. It acts better when given in water than when combined with tonics, as vegetable bitters or iron, and especially when administered in the night. I do not combine it with expectorants: indeed, in such cases as those under consideration, I believe, expectorants have an opposing action to that which is now sought for; and although they may, by a secondary action, relieve cough, they do it by exhausting the system. A full meal and a distended stomach, with either fluids or solids, even if the quantity be not large, is a frequent cause of cough and subsequent vomiting; and it is well to limit the quantity of food taken at a time, and especially of fluids which do not sustain the system. It is also imperative that the patient breathe through the nose only in changes of temperature, especially towards cold. Gum arabic dissolved quietly in the mouth, or strong suet and milk, in tablespoonsful, often taken and swallowed slowly, or an emulsion of oil and an alkali swallowed slowly, are often of great utility by their local influence.

Dyspnœa. Dyspnœa, or rather *short breathing*, is to be relieved by the distension of the lungs before mentioned, and also oftentimes temporarily by vesicular eruption on the chest, caused by such excitants as croton oil, provided it be maintained of moderate intensity and for a lengthened period. The action is doubtless derivative, as is also that of the application of turpentine, either hot or cold, and both; but especially the latter. It has probably a further advantage in stimulating the muscular structure beneath the skin. Calisthenic exercise, of all the inspiratory muscles particularly, would also benefit in this direction.

Tonics. In addition to the foregoing it is needful to administer tonics. Their mode of action is not well known, and hence the selection of them is somewhat empirical, and their indiscriminate employment is not beneficial. They are borne the best when the disease is quiescent, and when the functions are in tolerable order, but they are not well borne when the cough is very troublesome; when there is a remarkable degree of nervous exhaustion and susceptibility; when inflammatory complications exist; or when the digestive and biliary functions are disordered. Hence, whilst they constitute the staple treatment in chronic phthisis, they can but seldom be employed alone, and must oftentimes be temporarily discontinued. Aperients are a most frequent adjunct; and whilst tonics may be administered during the day, a simple sedative is required for the night. The best tonics are quinine, gentian or quassia, with iron.

In the excited state of system, to which I have more than once referred, but which is seldom found in the first stage of phthisis, the most satisfactory treatment is the employment of salines with sedatives, and to impress the patient with the importance of his own endeavours to remove this condition.

Chest pains. The *pains* in the muscles, tendons, and ligaments of various parts of the thorax, are evanescent, but they recur, and are of a nature not easily borne by one whose nervous system is sensitive. Moreover, they are not readily amenable to treatment. As I believe that the nature of this pain is peculiar and not understood, it is impossible to apply remedies with scientific accuracy; but the least unsuccessful plan is to exhaust the nervous sensibility directly or indirectly. As direct agents, perhaps belladonna and opium are the best; whilst the most valuable indirect ones, are blisters, croton oil liniments, and turpentine stupes; and I think the former are sufficient in the earlier stages, and the latter are the most successful in the later ones. The influence of acetic extract of colchicum and opium is oftentimes very good, but it is far from being uniform.

TREATMENT IN THE LATER STAGES.

This essentially consists in retarding the waste of the patient, and in averting or removing inflammatory complications, or such accompanying diseases as those of the kidney and mucous membrane of the bowels, and is truly palliative or protective. It will be unnecessary to enter into this part of the subject with any minuteness, and therefore I shall content myself with the mention of such modification in the plan already laid down as the new circumstances require.

At this period the system begins to suffer from change of the blood, due to defective nutrition, and tending yet more and more to the wasting of the patient.

Hæmorrhage is in part now due to this circumstance, as well as to the destruction of the tissue of the lung, which is now proceeding: but even yet, it requires for its immediate occurrence the influence of some such powerful agent as cough or exertion. The treatment will now be repressant in whole or in part, and gallic or tannic acids with the mineral acids, are the best remedies; but, in periods of danger, turpentine is the most to be relied upon. How far derivatives may even then be of service, must depend upon the circumstances of each case.

Cough is now almost always associated with, and in great part is due to, the conditions of the pharynx and fauces already described, and imperatively calls for local treatment, including the exclusion of cold air from the throat, and the application of nitrate of silver, &c., to the same parts.

I do not consider that even in this stage, expectorants are called for, except there be inflammatory complications.

Vomiting does not commonly require any direct treatment, but simply the indirect one of limiting the quantity of food, and especially of fluid food, at a time; and the prevention of cough by the administration of a gentle sedative soon before the meal. It is also needful to attend to the due action of the chylopoietic viscera.

The rapid pulsation and respiration call for the exclusion of any unnecessary excitement, for the lying posture, cool temperature, moderately moist air, and the avoidance of great sunlight. It is in this stage, if not too far advanced, that a winter's sojourn on the Nile is particularly useful.

Perspiration is to be retarded by limiting the quantity of fluid food; by avoiding air which is too moist; by maintaining as far as possible the action of the lungs and kidneys; by due arrangement in reference to clothing, posture, and exercise. When it occurs in the night it will be needful to remove feather beds, bed-fellows, bed-curtains, and excessive clothing, and administer cold tea and food.

The oxide of zinc, in five-grain doses, has been found, at the hospital, to be a most valuable remedy; and one-sixteenth of a grain of morphia may be associated with it when given at night. It is of great importance to maintain a suitable temperature of the skin and extremities, by clothing, friction, and exercise.

Pleuritic pains are, I think, best relieved by blisters and the iodine paint.

In reference to the employment of cod-liver oil as a remedy for the wasting, and with the view of improving the condition of the blood, I believe the proper course to be, to ascertain if the patient still take a moderate quantity of fat food. If he do not, then to endeavour to induce him to increase it moderately, by the use of suet in pudding, an increased quantity of butter, or of suet and milk for supper; and if this can be effected, I do not see the necessity for cod-liver oil, except with the view of producing a local effect on the throat. If he be poor, and unable to obtain suitable food, including fats, I regard cod-liver oil as being then applicable; as it is also in some instances in which, with every encouragement, the patient cannot be induced to take a proper quantity of fat food.

I think it of importance to limit the diet, as far as possible, to solids, and chiefly to meat, eggs, and saccharine and farinaceous food; to the partial avoidance of succulent vegetables; and the fluid should be almost restricted to milk and tea, and administered in small quantities, and frequently.

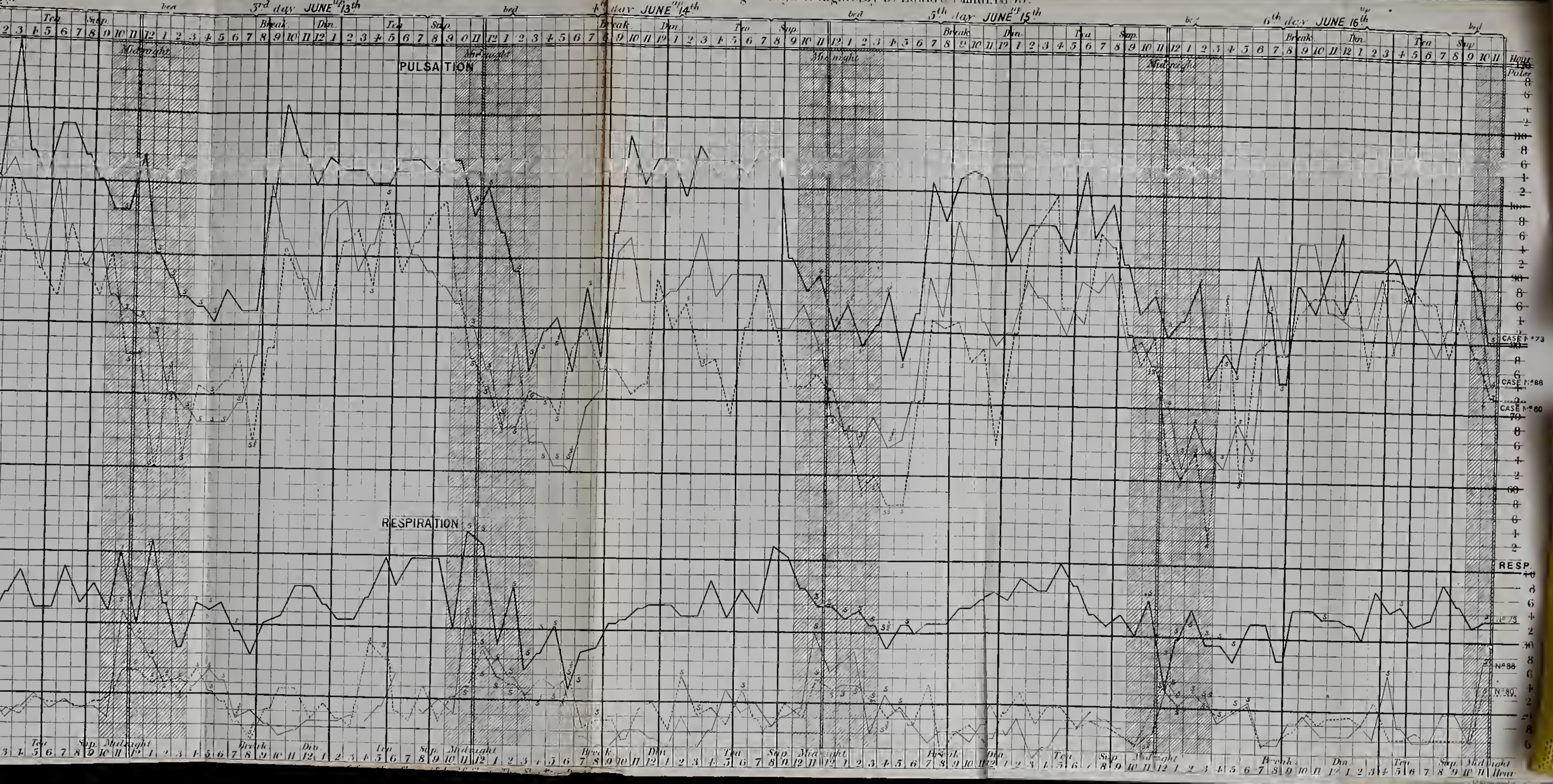
The appetite should be carefully protected and encouraged, and the digestive function duly supported.

In bringing this paper to a close, I feel it to be scarcely necessary to call attention to the removal of whatever conditions may have given rise, or have tended to give rise, to the disease: such, for example, as deficient food or clothing, anxiety, excessive or defective bodily exertion, abuse, occupation, residence, and impure air; since it is evident that to remove an effect implies, at least, the removal of the cause. But I would venture very earnestly to ask the attention of my professional brethren to two circumstances: First, to appreciate fully the existence of a pre-tubercular stage, and its importance as the only period for successful treatment; feeling assured that this is a first and a necessary step to a better acquaintance with the subject by the public in general, and to the application for medical aid under these favourable circumstances. It would also give a definite view to the treatment adopted with feeble youths of both sexes, with a view to improve their general health, and be a measure of the importance and progress of the case. and, second, to believe, and to induce the public to believe, that fatal and prevalent as the disease is, it is one largely capable of prevention. May the period yet arrive when, whilst retaining the many advantages of our day, we shall in no small degree exchange our enervating brain-working and money-seeking habits for some of the breath-exciting practices and rustic simplicity of times not yet out of memory.

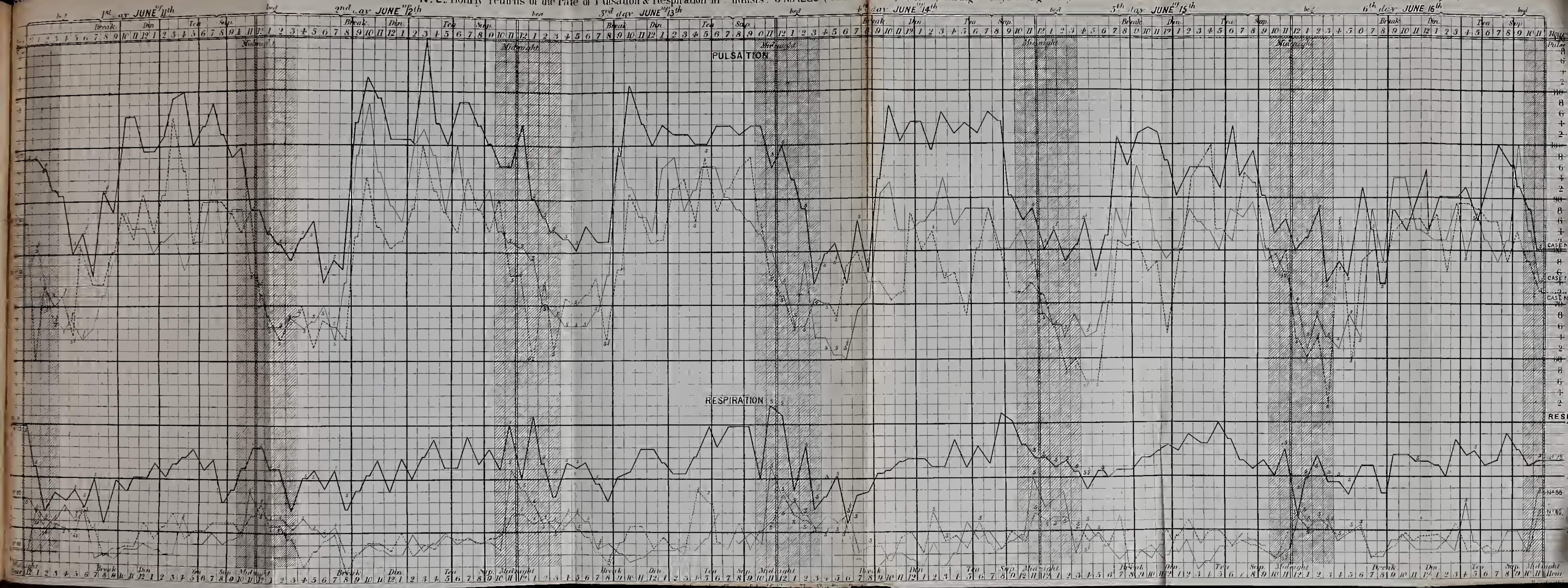
63, Grosvenor Street, London.

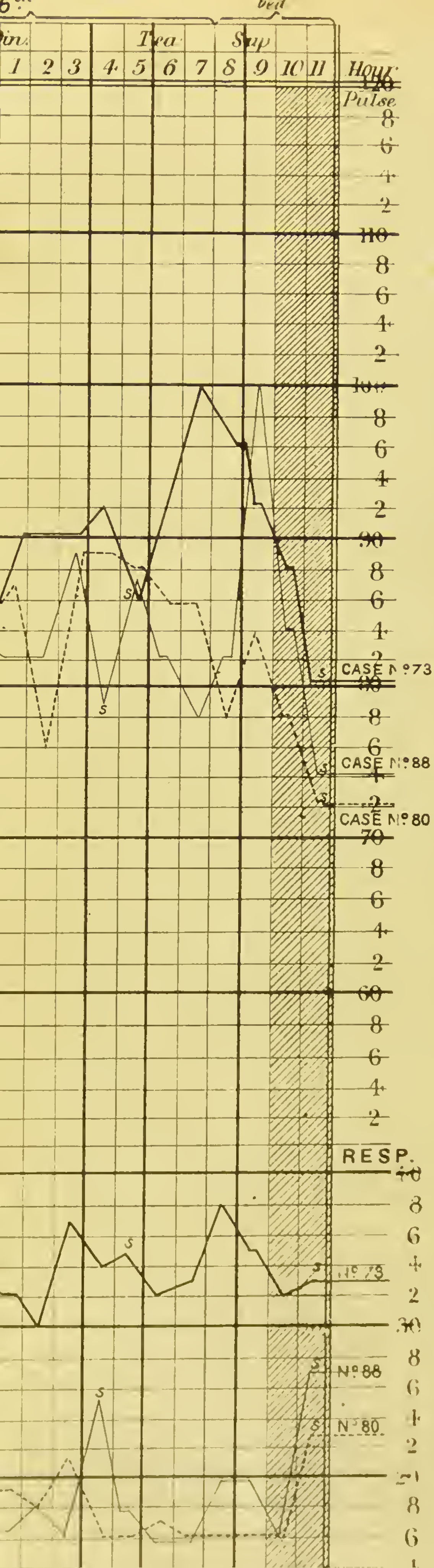
Birmingham: Printed by JOSIAH ALLEN, Jun., 10, Livery Street.

N° 2. Hourly returns of the rate of Pulsation & Respiration in Phthisis. 3 MALES (Cases Nos 73, 80 & 88) during 6 days & nights, by Dr Edward Smith. 1855.



Hourly returns of the rate of Pulsation & Respiration in

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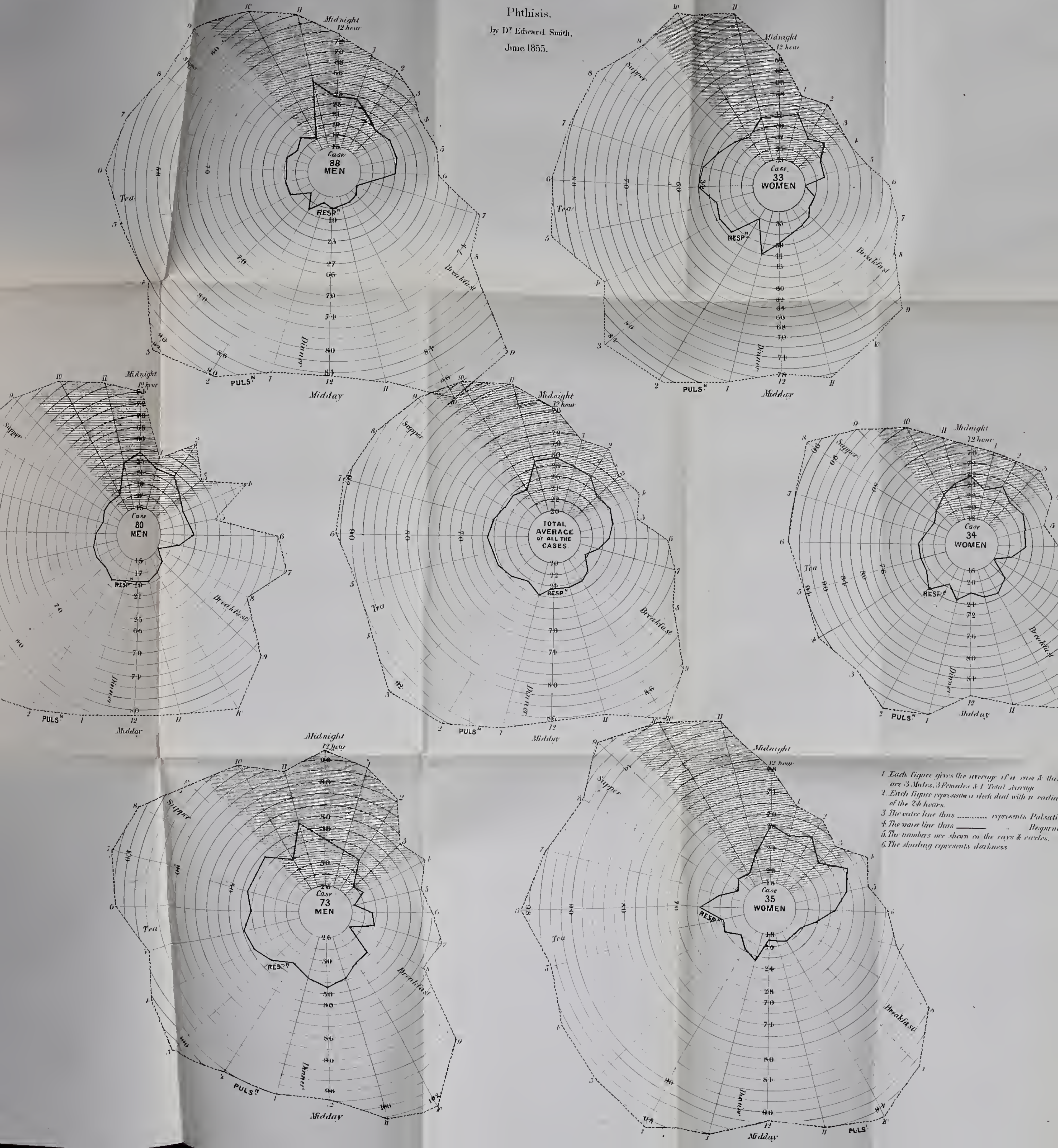
No. 3. AVERAGE (6 days & nights) Hourly Pulsation & Respiration
in
Phthisis.

by Dr Edward Smith,
June 1855.



1 Each figure gives the average of a case & the
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2. Each figure represents a clock dial with a readin
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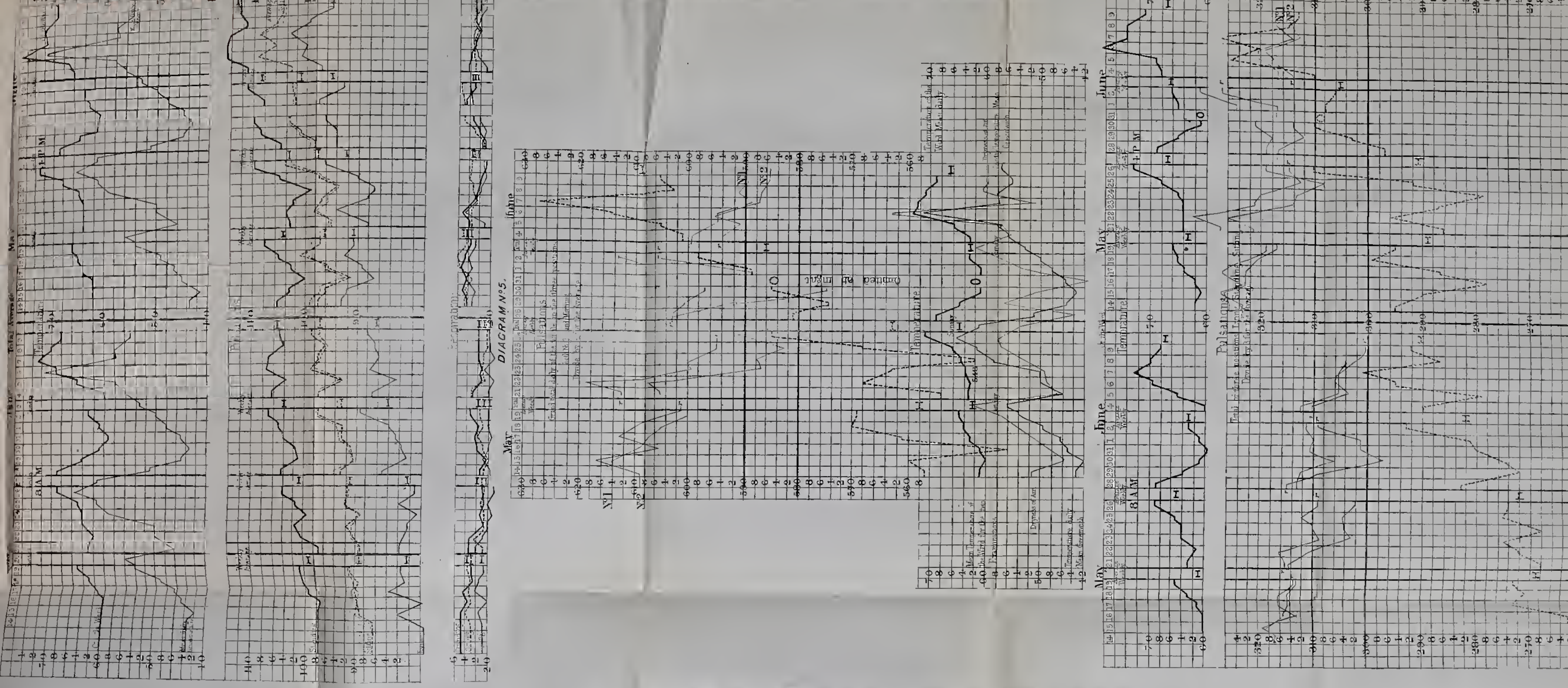
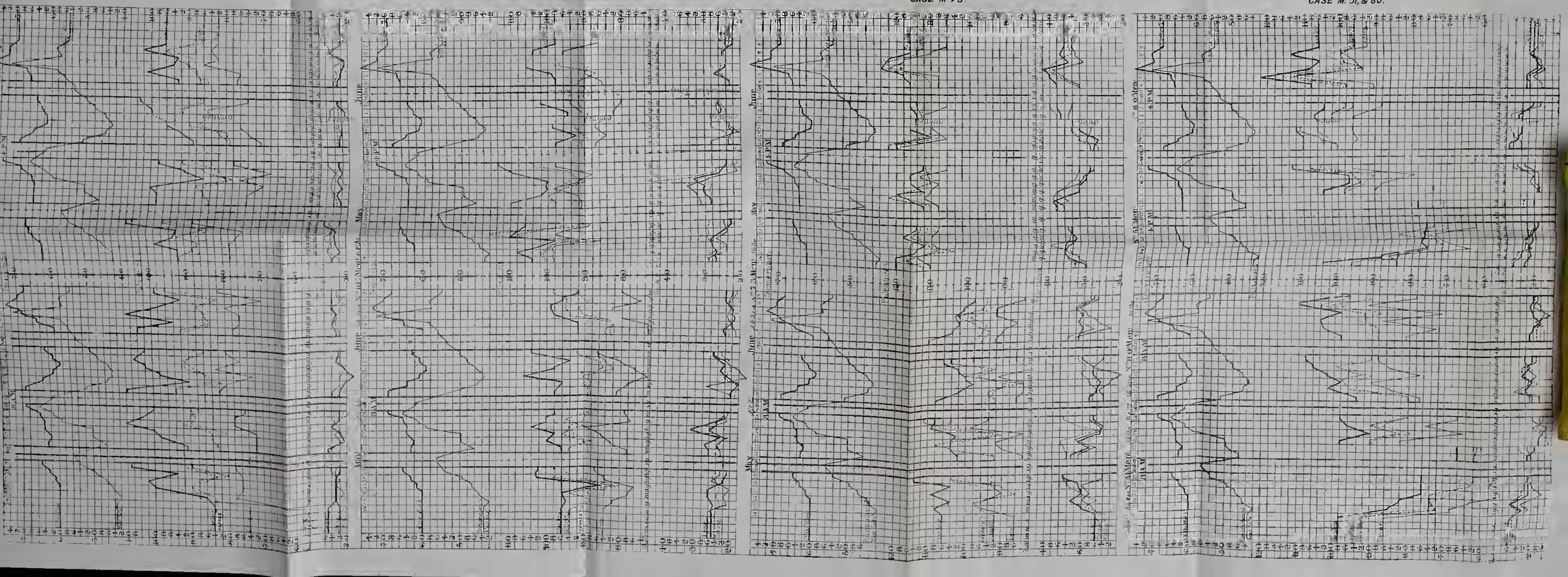
3 The outer line thus .... represents Pulsati
4. The inner line thus ______ " Respira
5. The numbers are shewn on the rays & circles.
6. The shading represents darkness

DIAGRAM TO Dr EDWARD SMITHS PAPER ON THE RATE OF PULSATION & RESPIRATION IN PHTHISIS



No 4 DIAGRAM TO Dr EDWARD SMITHS PAPER ON THE RATE OF PULSATION & RESPIRATION IN PHTHISIS



CASE M.65.

CASE M. 107

CASE M 73.

CASE M. 51, & 80.